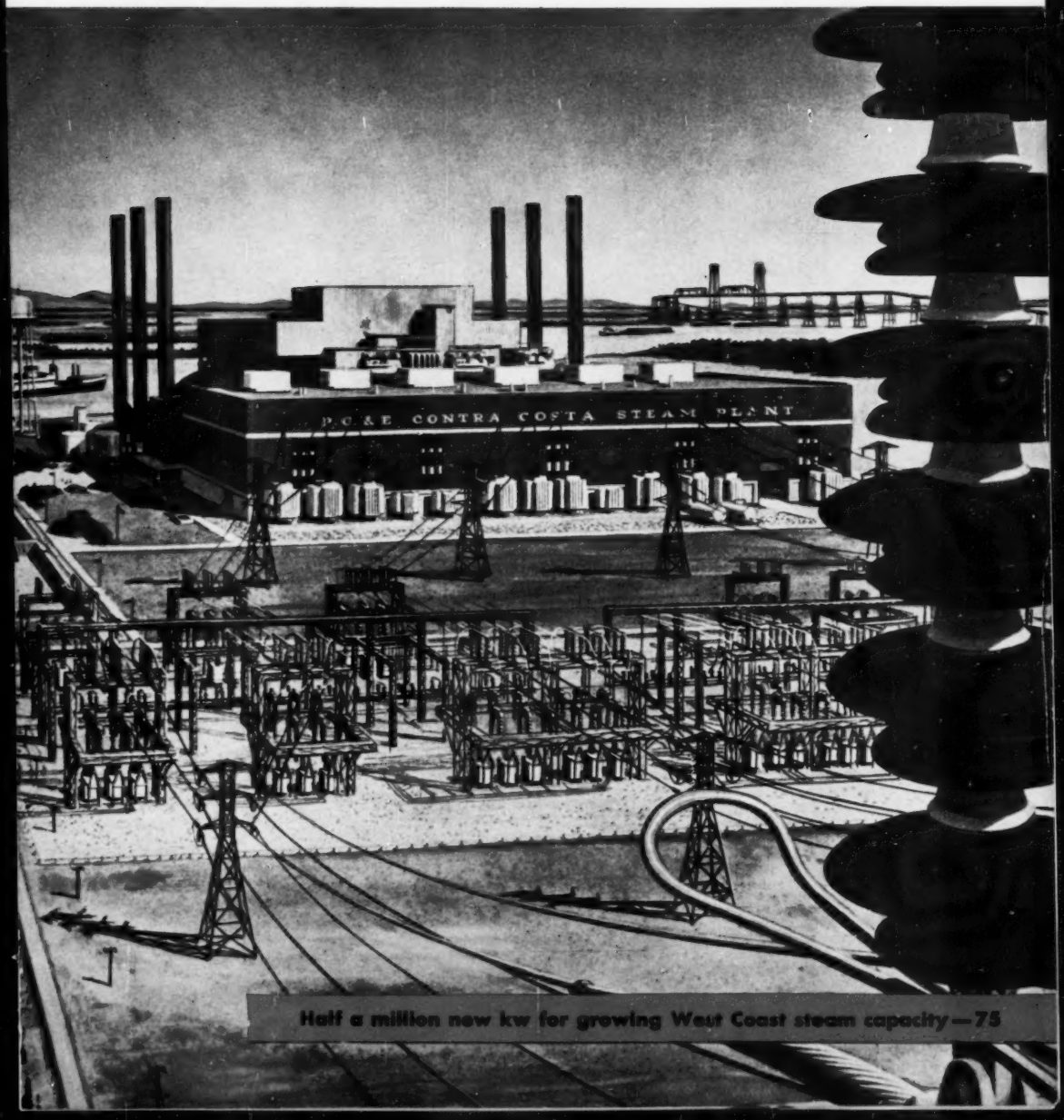
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

RR LICKS SMOKE · 82
EXPANDING WITH 13.8 KV · 96
TRAP POINTERS · 112

Power

February
1952 · 50¢

A McGRAW-HILL PUBLICATION



Half a million new kw for growing West Coast steam capacity—75

Delaware Power & Light Company's new Edge Moor Power Station near Wilmington, Delaware. In the background is the recently-dedicated Delaware Memorial Bridge.

Ash and Dust Handling at EDGE MOOR STATION

Hydrojet and Hydrovac Systems have been installed in the Delaware Power & Light Company's new Edge Moor Power Station to provide efficient handling of the ashes and dust. This 140,000-kw generating plant, located just outside Wilmington, Delaware, was recently put into full and regular operation.

The installation features two 600,000-lb-per-hr three-drum radiant-type steam generating units, having dry hopper bottoms with shaded ash pits. Bottom ash is sluiced from the flooded ash pits once every shift, and is then pumped to a settling and dewatering basin outside the plant. Fly ash from the mechanical dust collectors and from the bases of the 220-foot stacks is removed pneumatically by a push-button-controlled Hydrovac System.

Find out for yourself why these Systems are in the better plants of today and in the better plans for tomorrow. Write for our latest bulletins on ash and dust handling.

THE ALLEN-SHERMAN-HOFF CO.

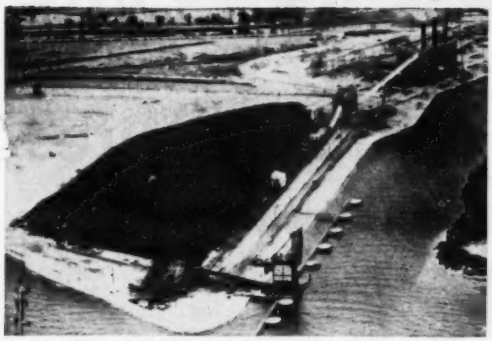
Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.

Offices and Representatives in Principal Cities

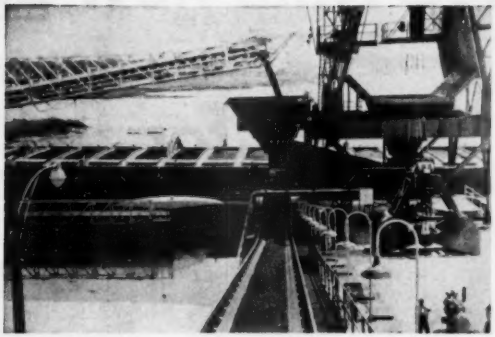
HYDROJET (hydraulic) **HYDROVAC** (pneumatic)

materials handling systems

LINK-BELT engineering experience...

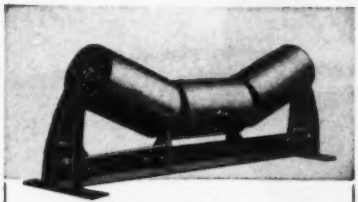


Link-Belt supplied this power plant with complete belt conveyor system for unloading, storing and reclaiming coal.

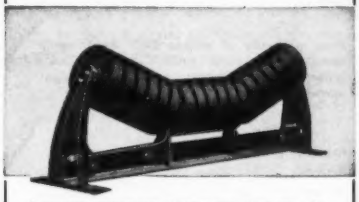


Receiving end of belt conveyor system, showing boat self-unloading coal into hopper. Another hopper and feeder handle barge coal.

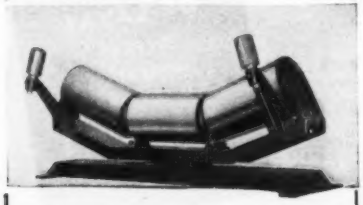
Plus LINK-BELT quality components...



SERIES 100 TROUGHED BELT IDLERS. Strong, balanced integral rolls revolve on high-grade roller bearings, Grease-in, dirt-out seal, large reservoir preserve lubricant.



RUBBER-TREAD IMPACT IDLER for loading points protects the belt by absorbing the shock of heavy materials or lumps delivered from above.



BELT-TRAINING IDLER for automatic belt positioning. The actuating rolls respond to slightest contact — quickly recede and center the belt to minimize wear.

...add up to your best bet in

BELT CONVEYORS

WHAT'S your materials handling problem? Tonnage, distance or a combination of the two? Heavy or light materials? Large lumps or fines? Continuous or intermittent operation?

Whatever the conditions, you'll find the right answers at Link-Belt. For Link-Belt designs conveyor systems to meet your requirements. Backed by unmatched materials handling and power transmission experience, our conveyor specialists help you and your consultants get the right equipment in the right place.

One Source—One Responsibility

Link-Belt makes all the various elements — all types and sizes of idlers, takeups, pulleys, trippers, bearings and power transmission drives. Plus all related equipment — other types of conveyors, feeders, elevators, car dumpers and shakers.

And Link-Belt will build your supporting structures and enclosures . . . install the job completely. One source — one responsibility. Every detail receives the proper attention to assure you an efficient, trouble-free, long-life conveying system.

The next time you need belt conveyor engineering assistance, call the Link-Belt specialist in our office near you.

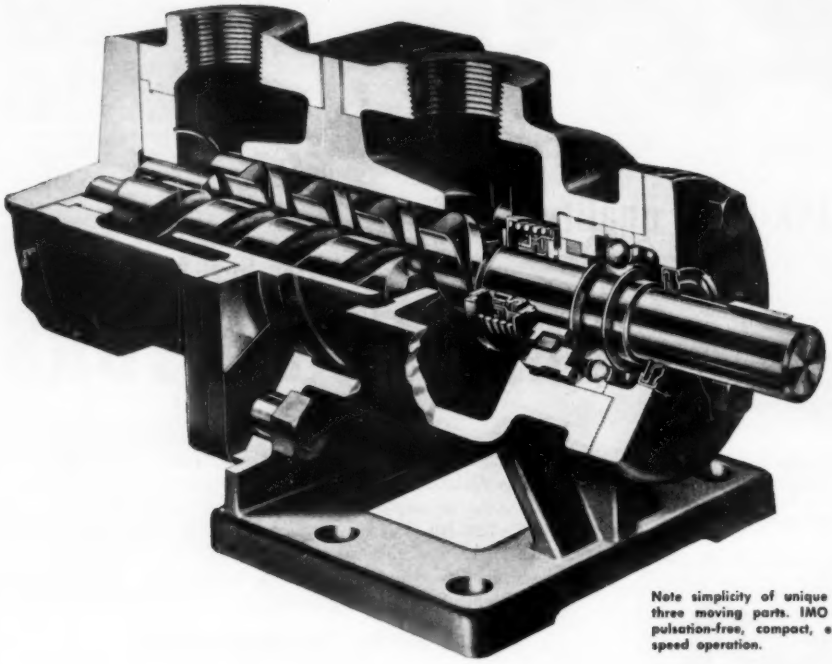
LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities. 12,300-E

NOW...a new **LOW-COST** IMO

for HIGHER pressures



Note simplicity of unique IMO design—only three moving parts. IMO is reliable, quiet, pulsation-free, compact, excellent for high-speed operation.

You've either heard about or used the proven De Laval—IMO A313A pump. Now De Laval brings you the A313B IMO for a wide variety of oil handling applications for higher pressures. This quality-designed, quantity-produced pump saves you up to 40% in initial cost over other IMO models for pressures up to 275 psi.

This new rotary positive displacement pump gives you all the advantages of the famous IMO pumping principle. Use it for capacities to 80 gpm, pressures to 275 psi and intermittent pressures to 325 psi... It handles light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication, governing systems and similar services.

DE LAVAL OFFERS IMMEDIATE DELIVERY OF NEW IMO PUMP! WRITE TODAY!

DE LAVAL *IMO Pumps*

STANDARD PRODUCTS DIVISION

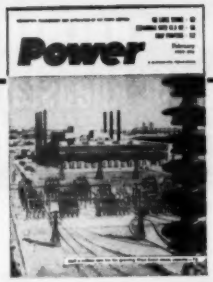
DE LAVAL STEAM TURBINE CO., TRENTON 2, NEW JERSEY

DL-124

Power

FEBRUARY 1952 VOLUME 96 NO. 2

combined with Operating ENGINEER



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February 1952 **POWER** Vol 96—No. 2

(Member ABC and ABP)

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own index annually, copies of which are available on request to the editorial offices.

STEAM CAPACITY on the West Coast continues to grow by leaps and bounds as demand outpaces hydro potential. Typical of this trend is PG&E's new Contra Costa plant at Antioch, Calif., with 300,000 kw installed and 200,000 under construction. For the job of paralleling hydro capacity, design provides ability to go from light to full load in a matter of seconds. To see how this is done, and for other interesting features, turn to p 75 where we take you through this semi-outdoor station.

Unusual view of Contra Costa appearing on our cover was drawn for *Bechtel Briefs*. That magazine reports the far-flung activities of the employes of Bechtel Corp, engineers and constructors for this plant, and for projects all over the world.

Next month . . .

■ For concentrated dope on what new plants are like, POWER's Modern Plant Survey is hard to beat. It tabulates design information on about 500 steam plants, both central-station and industrial, and on more than 125 hydro developments in U.S. and Canada. And to wrap it all up, there'll be graphical summaries of engineering trends.

■ For some kinds of corrosion problems, cathodic protection is the answer. To see if it will cure your headaches, read Shep Powell's March review of basic principles.

■ Didn't get to go to Philadelphia for the Maintenance Show? All's not lost, you'll find the highlights reported for you in the Plant Operation and Maintenance Section.

■ If you treat them right, induction motors purr along smoothly, give no trouble. But if trouble does crop up, you want to spot the cause in a hurry, get the jump on fixing it. That's when you'll use next month's induction-motor check chart.

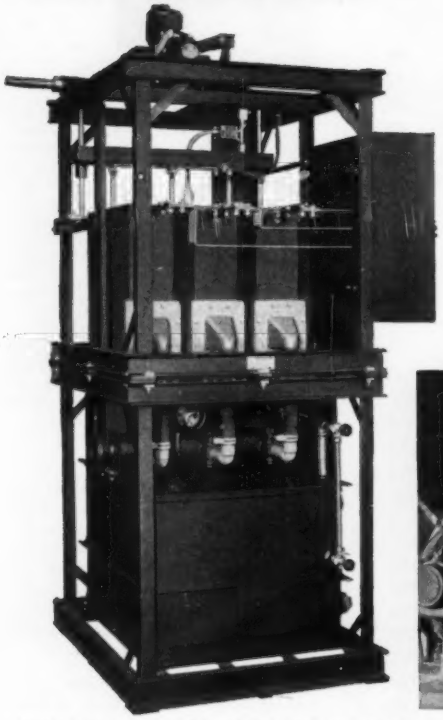
. . . and future months

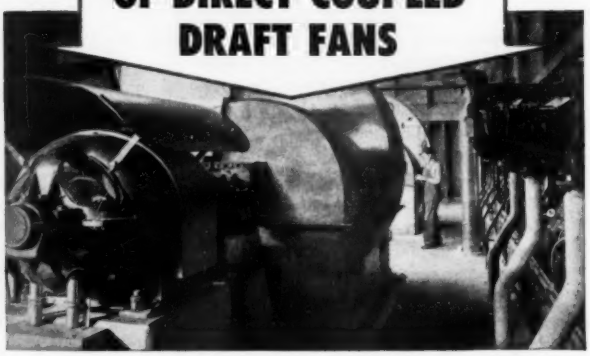
■ More and more power men are using wired TV for jobs like watching water level, observing furnace conditions. So Jim O'Connor is readying a down-to-earth article to tell you how it works, where and when to use it.

ALLIS-CHALMERS
Liquid Rheostat
POWER PLANT CONTROL

Stepless Speed Control

OF DIRECT COUPLED DRAFT FANS





Speed of the direct coupled forced draft fans shown at right is controlled by remotely located Type 257 Liquid Rheostats.

FOR PROPER DRAFT CONTROL of boilers, use Allis-Chalmers Type 257 Liquid Rheostats in the secondary of wound rotor motors driving forced or induced draft fans.

Stepless speed control of Type 257 Liquid Rheostats is engineered to give straight line relationship between motor speed and rheostat electrode position. Equal sensitivity of speed control over the entire regulated range is assured.

Floor space is saved by compact design. Only electrical connections are required. Direct coupling of fans and driving motors simplifies bearing alignment and maintenance problems . . . saves space . . . insures continuity of service.

Low Maintenance. Type 257 Liquid Rheostats have but few moving parts . . . no arcing contacts. Electrodes can be actuated by electric, pneumatic or hydraulic operators and give full resistance range in approximately ten inches travel.

Call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin for leaflet 14S7544. A-3423

ALLIS-CHALMERS

WOUND ROTOR PRIMARY MOTOR CONTROL

Make your Boiler Draft Fan Drive all Allis-Chalmers. Use the Type 257 Liquid Rheostat for secondary speed control, an Allis-Chalmers Type "H" Starter for primary control (bul. 14B6410A), and an Allis-Chalmers wound rotor motor.

ORDER TELEGRAPH SYSTEMS

The Allis-Chalmers Order Telegraph System is accurate and reliable . . . can be depended upon even during station power failure because it uses the dc bus for its power source. An alarm system operates until the order is returned correctly. Select either five or ten-inch semi-flush dials. Use it to transmit orders between switchboard and turbine room.

Power

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...with Power readers...

PLENTY ORCHIDS, NO BRICKBATS . . .

POWER's *Handbook on Bearings and Lubrication (Dec 1951) drew many heartwarming comments from readers and industry authorities. Here are some excerpts:*

We just want to congratulate you on the excellent job which you have done in this handbook, especially the illustrations. I have been in the bearings game for 28 years and I am very sincere in saying these are the best illustrations and examples of bearings I have had the opportunity of seeing.

Indianapolis, Ind. — R F CROM, *McQuay-Norris Mfg Co*

. . . I have never in all my shop experience and association with plant and development engineers seen an article on lubrication so well discussed and illustrated and holding so much interest through the diversified field of our activity here.

Portsmouth, Va. — F J CULBERT

I distributed two copies of your Handbook to our people. . . . I have been flooded with requests for additional copies for use by men in our Works Laboratory and Motor Departments. They say it is an excellent job and will prove extremely useful to them as a reference source.

Schenectady, N. Y. — W F STOLBERG, *General Electric Co*

(*Continued on page* 236)

...lines and bylines

G V Williamson

BURNING COAL, and the problems that come with it, has been one of Gerry Williamson's prime concerns since he went with Union Electric Co of Missouri back in 1922. That organization, you'll remember (as does Gerry), was a pioneer in pulverized-coal firing by bin system, and later by direct system. He now supervises over a million kw of such firing. And he's currently chairman of Edison Electric Institute's Prime Movers Committee, a fellow of ASME.

With his long background in fuels and firing, it was only natural for Gerry to take an active part in reorganizing the Air Pollution and Smoke Prevention Assn of America. And, we might add, to write the thought-provoking article on stack design beginning on p 88 of this issue.

Right now, Gerry's interests center on development of large boilers in the St. Louis area, where million-lb-per-hr units have been installed at Venice Plant, and still larger ones are going in at Meramec and the Joppa atomic-energy plant.

T G Hicks

PROMOTIONS are big events in any family and the POWER family is no exception. So we think you'd like to know that, effective Jan 1, Tyler Hicks moved up from Assistant to Associate Editor. He came to us, a little less than two years ago, with an unusually well-rounded background in design and operation, plus considerable experience in writing for the technical press. These talents have been abundantly evident in POWER's pages.

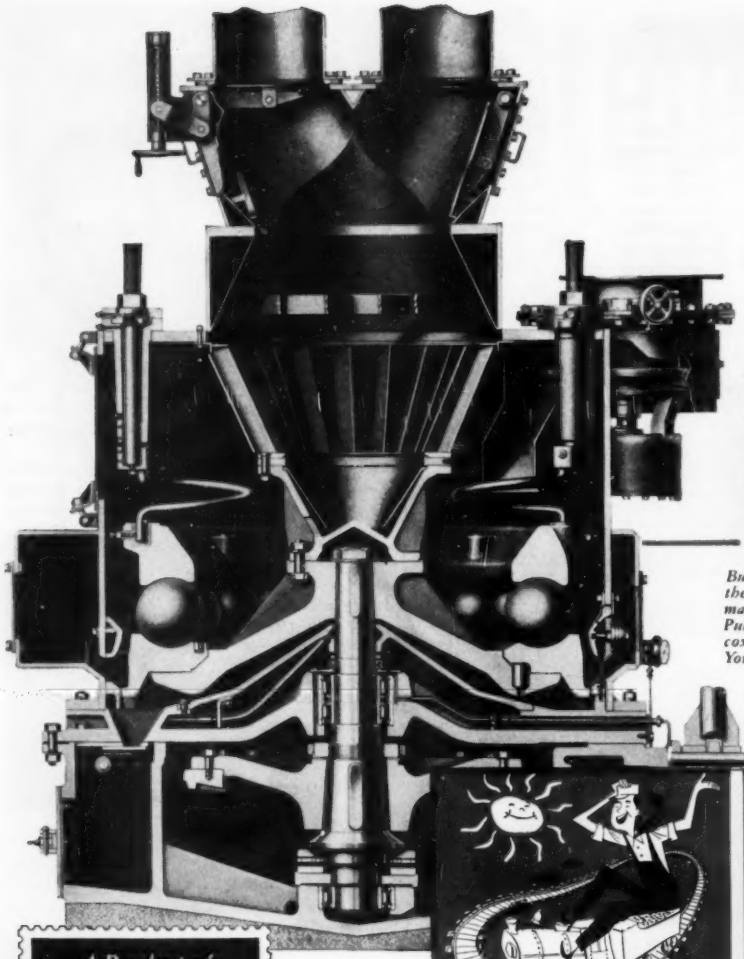
Announcing the promotion, Editor Phil Swain said "This is our way of indicating to Ty's associates, and to the world, that we recognize him as a full-fledged technical editor—sound in engineering, skilled in our ways of doing things, able to move out under his own steam to plan, organize and manage editorial projects."

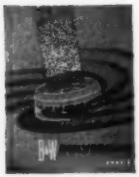
W H Wheeler

COMPRESSORS and their applications are an open book to W H Wheeler. They should be, because he's devoted his professional life to them. Born in Storrs, Conn., and a Yale graduate (BS, 1923), Wheeler served the compressor industry in a variety of engineering capacities. He's been with Worthington Pump & Machy Corp for 16 years, the past nine as manager of their vertical compressor division.

Many of Wheeler's contributions to compressor development have been made in extracurricular activities with industry groups, such as the Compressed Air and Gas Institute. He is now chairman of its Educational Committee. Wheeler is also past president of the Pneumatic Automotive Equipment Assn, and a member of the Engineering Society of Western Massachusetts.

He still finds time for power boating on Long Island Sound, but looks back a little wistfully on happy hours spent building a model railroad, which, he says, his sons outgrew. It was probably only the winter boating lull that enabled us to persuade him to put down for you some practical pointers on compressor selection (p 94).





Bulletin G-57 illustrates and describes the design, construction, operating, and maintenance features of the Type E Pulverizer. Write: The Babcock & Wilcox Company, 85 Liberty Street, New York 6, New York.

A Product of B&W Engineering for Economy

Recirculating Load—Dries as It Grinds

Recirculation of fines within the mill gives repeated, quick-drying contact with large masses of heated air and metal . . . produces proper fineness at all loads, even with coal as wet as it can get. Fines are classified in the mill.

Uniform Performance Regardless Of Wear

Balls and grinding rings wear together . . . assure uniform fineness regardless of attrition of the grinding elements . . . fineness automatically increases at reduced loads.

A big asset in *low-cost* power generation

The only accurate measure of pulverizer efficiency—*and ultimate cost*—is a function of availability, plus combined materials and labor maintenance per ton of product over long periods of continuous operation. B&W recently surveyed a representative group of utilities, covering a wide geographical area and broad range of coals. More than 100 B&W Type E mills were reported in service from one to ten years, and with aggregate product of 25 million tons:

- Average Availability: 96.5%
- Average total maintenance cost per ton: 3.12 cents

It will pay you to remember this outstanding—and typical—history of dependable, low-cost performance when considering your next pulverizer installation.

Blows Clean Air—Saves Wear and Tear

Unique in pressurized operation, the Type E Pulverizer requires remarkably little maintenance of the primary fan, because it blows only clean air . . . is not subject to the damaging abrasion of entrained particles.

One-Point Variable Fuel—Air Control

Like the accelerator on your automobile . . . assures proper coal-to-air mixture . . . produces desired rate of steam generation over a wide range with coal conditions suitable for sustained high combustion efficiency.

Low Power Consumption

Ball-and-ring grinding, anti-friction bearings, pressure lubrication, and automatic rejection of ungrindable materials make possible high output with minimum power demand.

Outstanding Performance Record

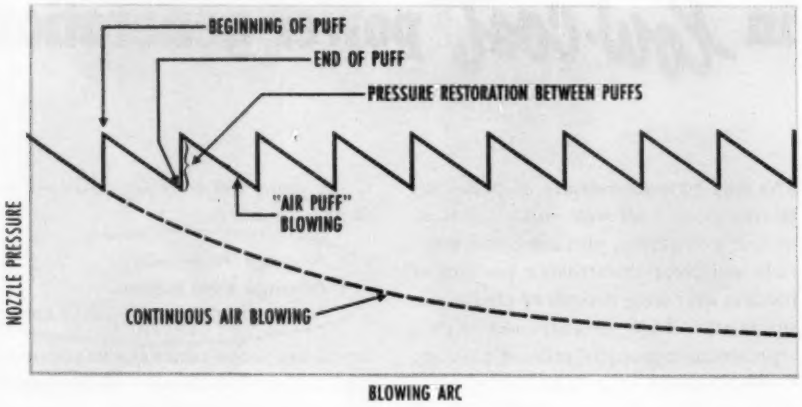
Availability and maintenance economy beyond today's most exacting requirements are proved in over 1300 Type E Pulverizer installations.

Helping Industry Cut Steam Costs Since 1867

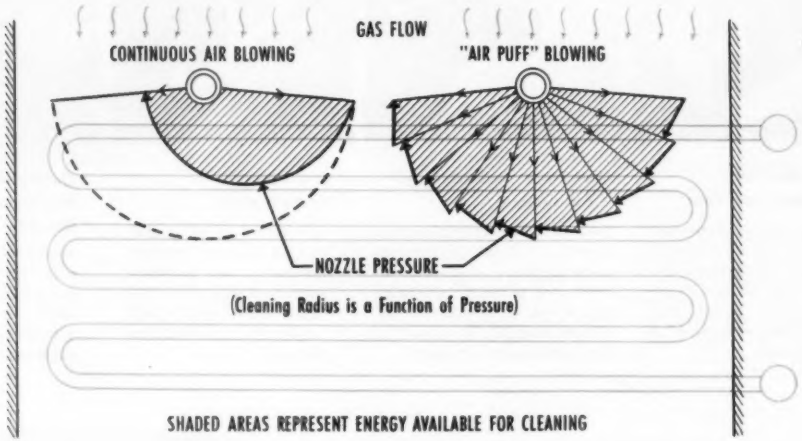
BABCOCK & WILCOX

G-5191

Controlled, HIGH SUSTAINED Air Pressure Throughout Each Puff
(Independent of Receiver Capacity and Compressor Size)



Representation of Typical Puffing Application
Puffs are Measured—Have Identical Travel Arcs


GAS FLOW
CONTINUOUS AIR BLOWING
"AIR PUFF" BLOWING
NOZZLE PRESSURE
(Cleaning Radius is a Function of Pressure)
SHADED AREAS REPRESENT ENERGY AVAILABLE FOR CLEANING

Why the Diamond Automatic "AIR PUFF" Principle of Soot Blowing means Cleaner Boilers at Lower Costs

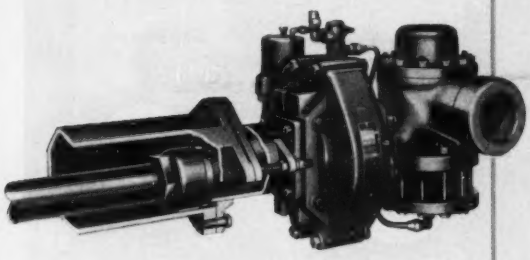
The Diamond Automatic "AIR PUFF" Soot Blower is a precision machine with all functions carefully controlled and interlocked to provide better boiler cleaning at lower cost.

Definite cleaning advantage is obtained; first, as a result of using air at high density as a cleaning medium, and second, by employing the well-known puff or "shock" method of creating a large number of powerful impulses.

As illustrated schematically on the left hand page, the controls function in such a manner that air issues from the multiple nozzles in *sustained* high pressure puffs that are independent of receiver capacity and compressor size. During each puff, the element rotates through a predetermined and measured short arc. Then the valve shuts off and the element stops rotating during the timed interval while the compressor restores the original air pressure . . . after which the valve reopens and the element starts rotating again for the next puff. The action is entirely automatic, and when the cycle is completed the blower shuts off. Each blower head is automatically started and operated in turn until the cleaning operation is completed.

This combination of *sustained* high pressure puffs with precise rotation of the element through a measured arc each time assures thorough cleaning at less cost. No air is wasted at low pressure when it cannot clean effectively. Controlled element rotation uniformly covers all the surface to be cleaned.

The Diamond "Air Puff" principle permits use of much smaller, less costly compressor and receiver equipment. Air puff blowers can be operated while the boiler is on automatic operation. Dust loading control is another important advantage. Control being entirely automatic, the expense and uncertainty of the human element are eliminated. For further information, write for Catalog No. 1014 U.



Model A2E Automatic "Air Puff" Soot Blower Head

Model AMC Master Controller

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

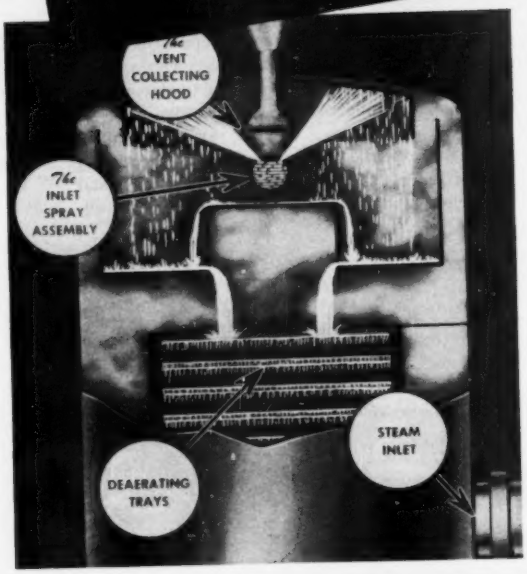
4621

ELLIOTT
equipment for power and process

They draw

ELLIOTT
DEAERATING HEATERS

Deaerating Heaters



Generators for Diesels

Turbine Generators

Large Motors

Centrifugal Blowers

Skyline views of most modern power plants

may show the Elliott deaerating heater mounted on its storage tank, as in the southern station pictured above. It is a symbol of liberty from the corrosive oxygen which it removes from boiler feedwater — a freedom which dates from the initial development of the deaeration principle by Elliott engineers.

This is the inlet spray unit and vent collecting hood, mounted inside the shell at the top. (See section drawing at left.)

The design of the Elliott deaerating heater of today virtually eliminates maintenance. The tubular vent condenser formerly used is replaced with an inlet spray unit and vent collecting hood that require no attention, and also cut down the unit's vertical dimension, important in limited headroom. Trays are of light stainless steel. Wherever undeaerated water contacts the metal, non-corrodible material is used.

The complete deaerating heater is built throughout in the Elliott shops. Full details are given in Bulletin N-16, mailed on request.

ELLIOTT Company

Deaerator and Heater Dept. • JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

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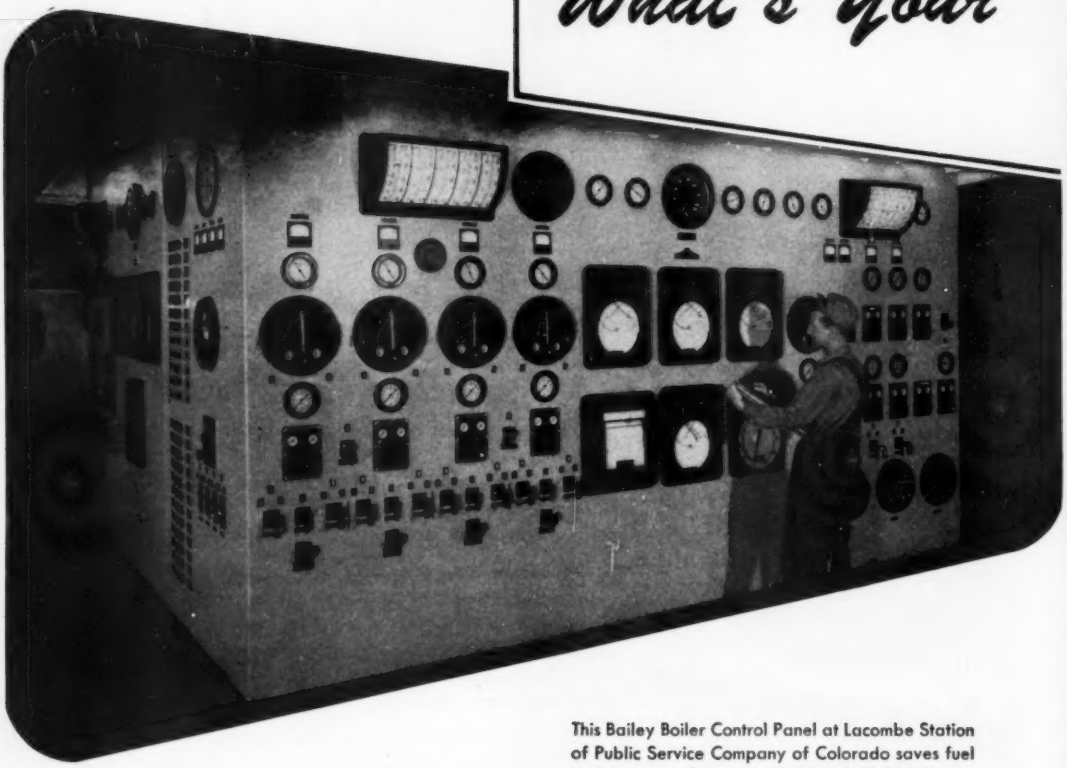
Q2-2

What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better control-dollar efficiency—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

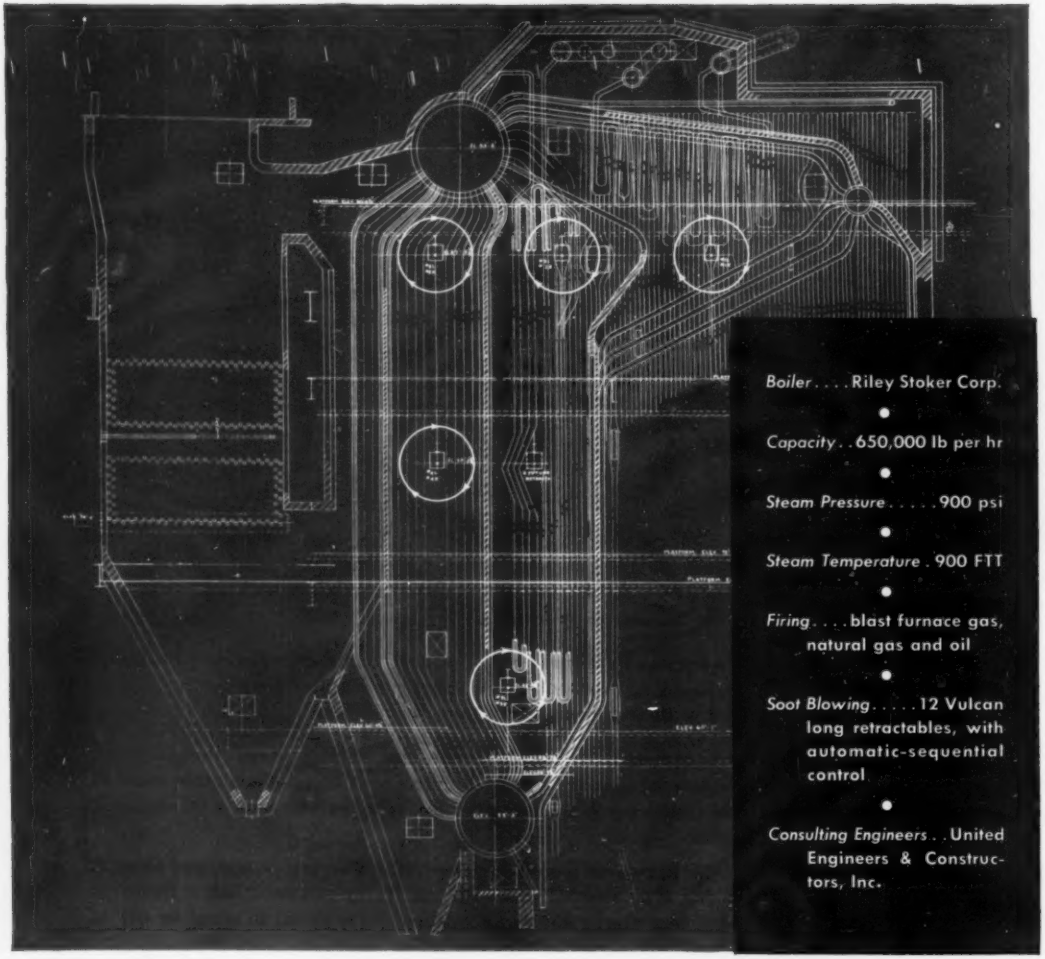
A-112-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

VULCAN

12 LONG RETRACTABLE BLOWERS AUTOMATIC-SEQUENTIAL CONTROL



Boiler . . . . Riley Stoker Corp.

•

Capacity . . 650,000 lb per hr

•

Steam Pressure . . . . . 900 psi

•

Steam Temperature . 900 FTT

•

Firing . . . . blast furnace gas, natural gas and oil

•

Soot Blowing . . . . . 12 Vulcan long retractables, with automatic-sequential control

•

Consulting Engineers . . United Engineers & Constructors, Inc.

VULCAN *Automatic*

at USS

UNITED STATES STEEL COMPANY

SOUTH WORKS · CHICAGO

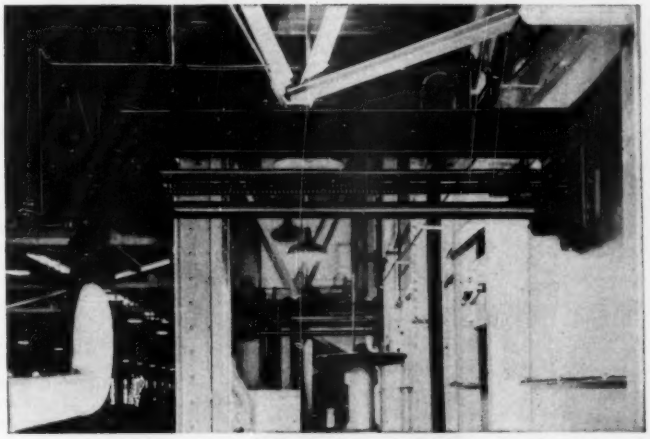
This boiler is cleaned by simply pushing a button. Operators need not even leave the panel to check the operation of the blowers, for the Vulcan Automatic-Sequential System reports back on each step in the cleaning cycle.

The story of Vulcan Automatic-Sequential Cleaning is told in Bulletin 483. Write for it.

VULCAN SOOT BLOWER DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
Du BOIS, PENNSYLVANIA

Standing at this panel, the operator can check each step of the cleaning cycle.

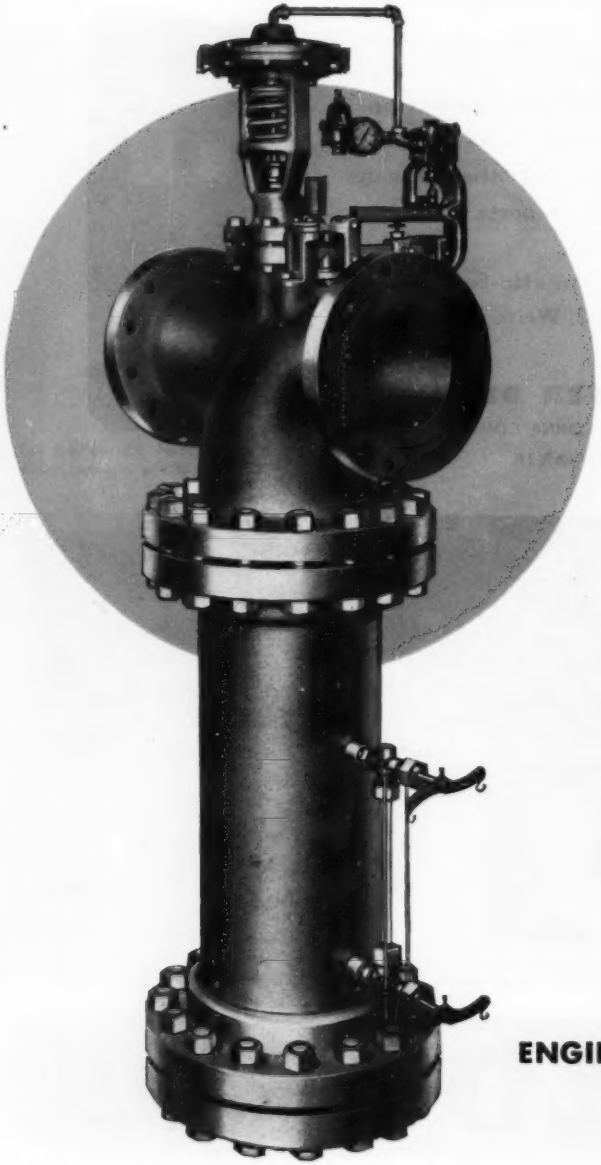
While steam is the blowing medium on this installation, Vulcans are designed to use steam or air, or both, without any change in equipment. Here the control is by means of air, but electric drive is also offered by Vulcan.



Vulcan long retractables have been built for travels up to 25 feet, and for maximum length require a clearance of only four inches between tubes.

Designed ONLY for

BUILT FOR PERFORMANCE



WHEN you select your pressure reducing and desuperheating station, you'll pay more if you buy COPES. But if your job is a tough one, you'll find COPES cheapest in the long run.

You'll be money ahead in installation, operation and maintenance costs, and you'll be getting *accurate* control—even down to your lightest loads, not just at your normal flows.

You'll get *quiet* operation—avoiding annoying chatter and destructive vibration.

The COPES DESUPERHEATER

You'll find it easy to install the self-contained COPES Desuperheater. It goes into the line as a unit, with only three connections. All accessories are furnished. You need no extra steam atomizing valve with extra stop valves—no long run of alloy-steel steam piping—no extra piping from the temperature element to the spray nozzle—no other extras.

You'll also find your COPES Desuperheater correctly sized for low velocities—for minimum noise, vibration and wear. You'll find temperature control accurate—even on lightest flows—because cooling water is controlled and completely atomized inside the mixing chamber. Adjustment is simple and permanent.

ENGINEEREED BY THE MAKERS OF

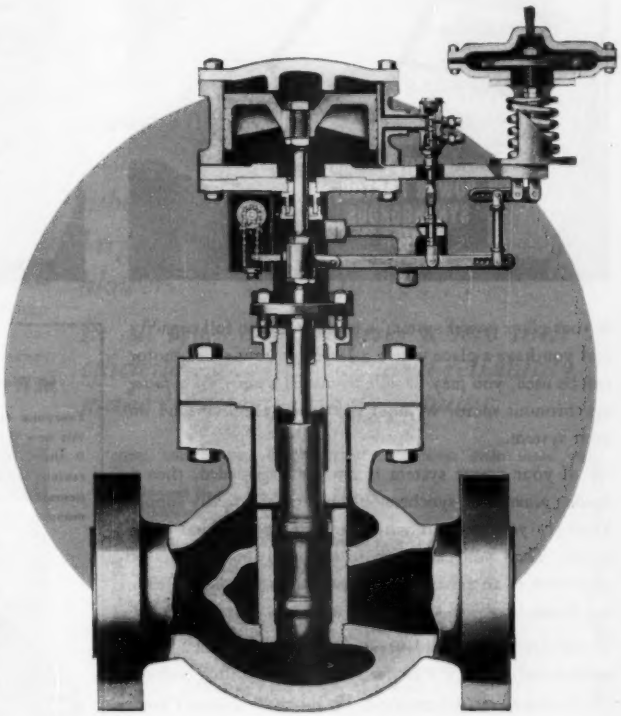
the TOUGH JOBS

NOT DOWN TO A PRICE!

You'll get 'round-the-clock dependability for years to come—with any adjustments or maintenance easily handled by your plant personnel.

It all adds up to the kind of performance you need for your tough jobs—results you cannot expect if you buy on price.

NORTHERN EQUIPMENT DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
221 GROVE DRIVE, ERIE, PENNA.



The COPES REDUCING VALVE

You'll find your COPES valve ports accurately designed for the correct capacities under the flow and pressure conditions you specify. You'll have no "hunting" to upset the precision of your control.

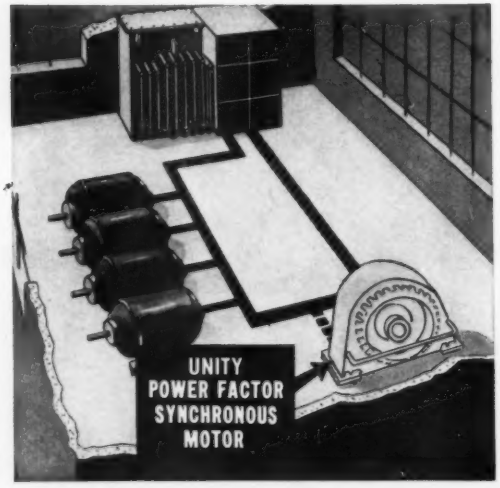
You'll find extra-heavy construction throughout. The valve piston is supported and guided in the areas subject to greatest velocities and forces. If these forces could cause excessive erosion, Stellite is welded to all contact surfaces before they are precision-ground to correct clearance for your installation. You'll find design and construction minimizes the possibility of sticking, leaking or vibrating. You'll suffer no objectionable noise.

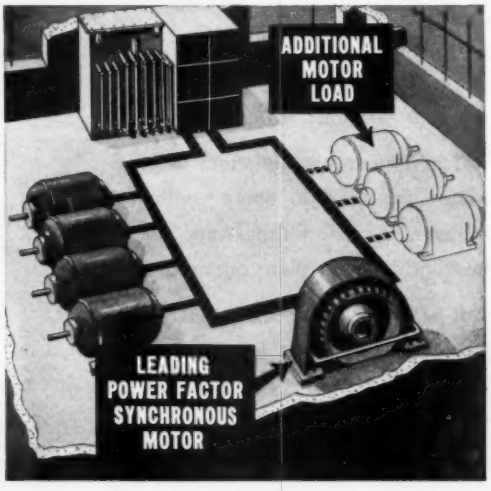
COPES

FEED WATER REGULATORS

How to get more out

. . . . *install G-E Synchronous Motors*





If your plant power system is loaded close to full capacity and you have a place where a large constant-speed motor can be used, you may be able to install a *unity power-factor* synchronous motor without increasing the kva load on your system.

Or, if your power system is already overloaded, then a *leading power-factor* synchronous motor can actually supply kvars to your system while performing its usual drive duties. Then you can often install additional inductive apparatus to an existing system without fear of overloading feeder lines.

If you are planning plant expansion or you need more motors and/or suspect power system overloading, contact the nearest G-E sales engineer. He'll help you survey your system, and help you determine the type of synchronous motor you need—should this be one answer to your power system problems. *General Electric Company, Schenectady, N.Y.*

NEW! A Helpful Training Course on Motors!

Everyone concerned with technical training problems will want this new G-E Motor Selection and Application Course. Consists of 9 short, easily understood lessons. Complete kit—slide films, review booklets and instructor's manual—$100. Call or write your nearest G-E sales office, or send for free copy of 96-page instructor's manual.

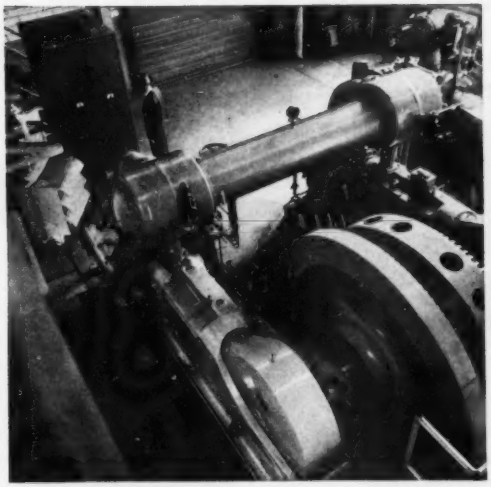
Look at the scope of this Course

1. Fundamentals of Motors
2. Types of Motors
3. Fundamentals of Selection
4. A-c Induction Motors
5. Single-phase Motors
6. D-c Motors
7. Synchronous Motors
8. Adjustable-speed Drives
9. Gear Motors

GENERAL ELECTRIC

# of your power system

for unity and leading power-factor drives

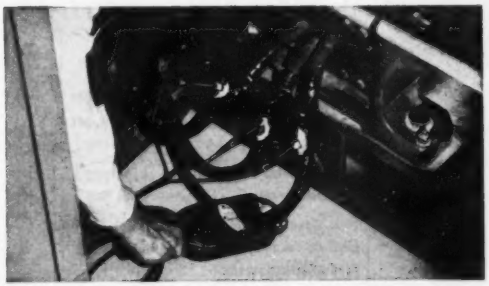


Control, too, will protect your system—G-E Limitamp high-voltage control provides ample interrupting capacity, protection for operating personnel, good appearance, and compactness. Here it controls and protects a 350-hp G-E synchronous motor.

G-E SYNCHRONOUS MOTORS ARE DRIVING . . . .

pumps
compressors
Jordans
beaters
crushers
ball mills
tube mills
large conveyors
blowers
saws
generators
rolling mills
pulp refiners
chippers
flour mills
stock refiners
line shafts
fans . . . .

in all types of industries where their efficiency, low first cost, and reliability make them exceedingly popular.



Check power factor on individual circuits—**easily, quickly—with new G-E hook-on power-factor meter. This portable instrument hooks around the line—no cutting of conductors, no costly shutdowns to make power checks. You can accurately locate those circuits where corrective action is needed.**

mail this coupon today

General Electric Co. Sect. AH 770-25
Schenectady 5, N. Y.

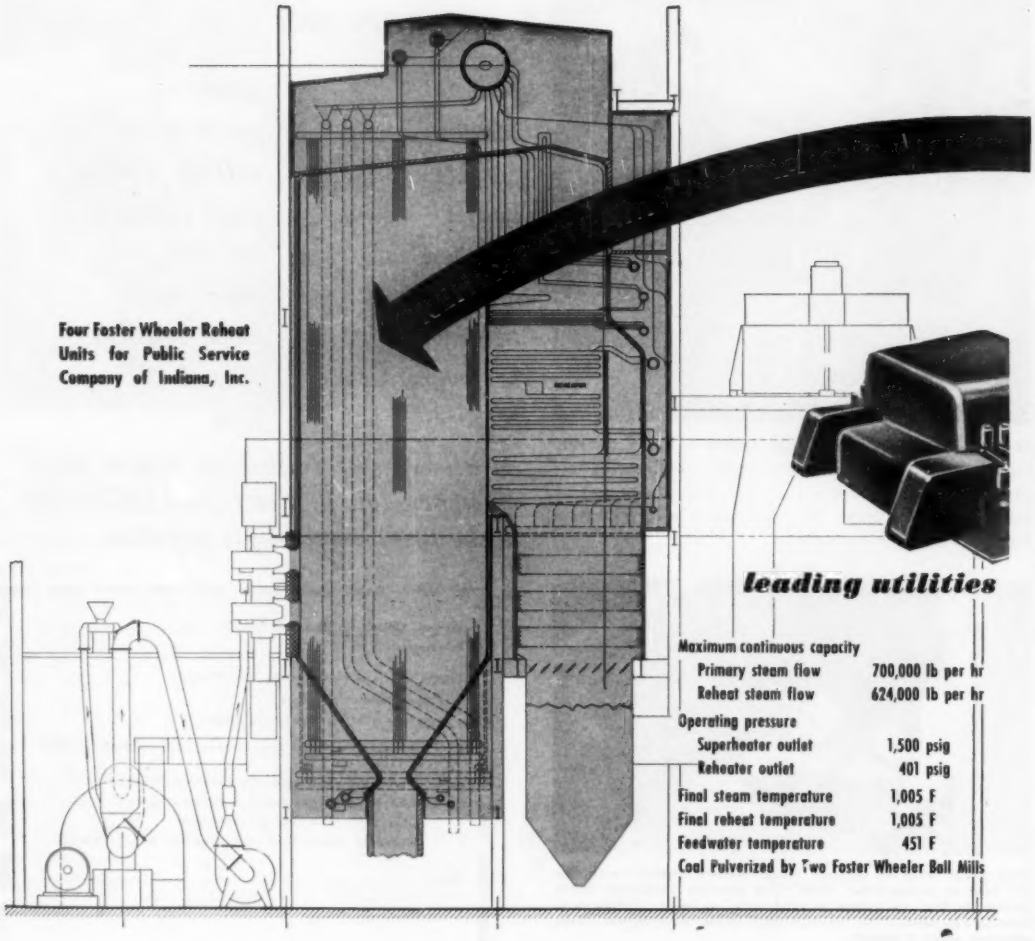
Please send me the following literature. . .

- ☐ for reference purposes
- ☐ for planning an immediate project

( ) GER-234—Synchronous Motors Do Two Jobs at One Time
( ) GEA-5332—Low-speed Synchronous Motors
( ) GEA-5426—High-speed Synchronous Motors
( ) GEA-5469—G-E Testing Instruments
( ) GEZ-310—Motor Training Course Instructor's Manual

Name .....
Company .....
Address .....
City ..... State .....

Integrating

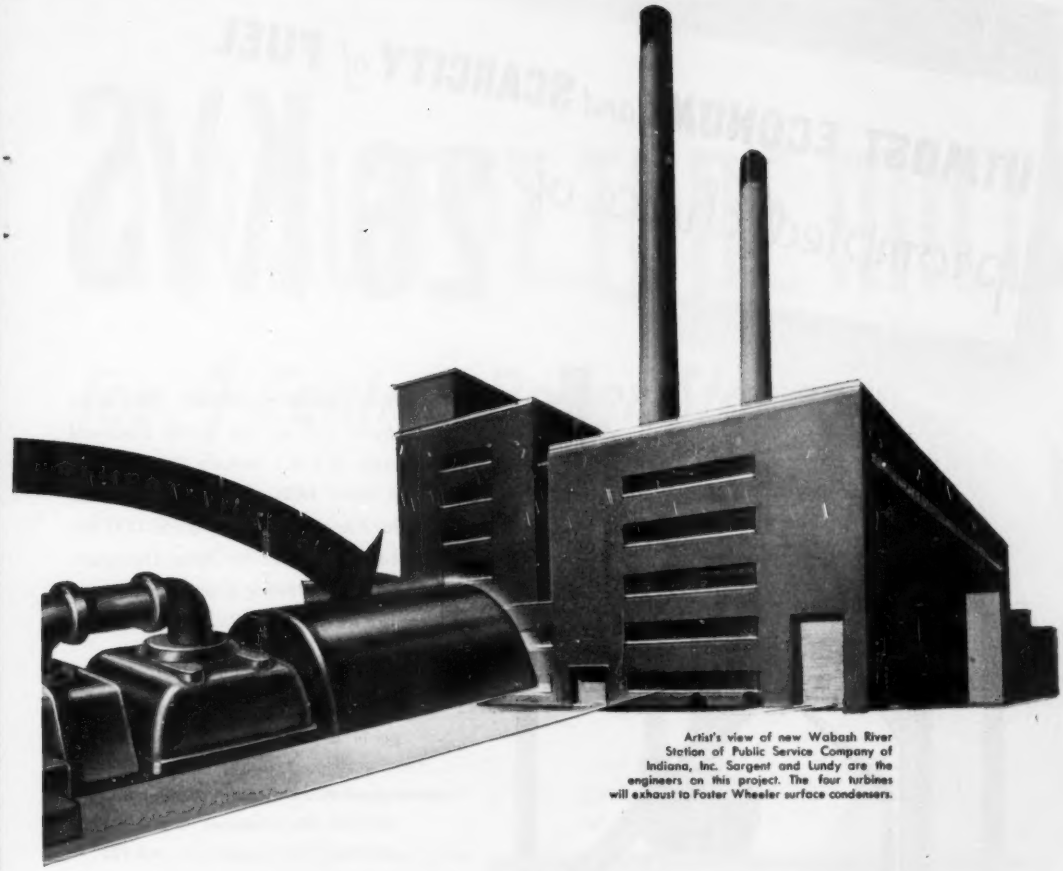


Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

leading utilities

Maximum continuous capacity	
Primary steam flow	700,000 lb per hr
Reheat steam flow	624,000 lb per hr
Operating pressure	
Superheater outlet	1,500 psig
Reheater outlet	401 psig
Final steam temperature	1,005 F
Final reheat temperature	1,005 F
Feedwater temperature	451 F

Coal Pulverized by Two Foster Wheeler Ball Mills



Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

are ordering Foster Wheeler reheat steam generators

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

The reheat steam generator illustrated is designed with a combination radiant and convection superheater and an all convection reheater. The chief advantages of this type of Foster Wheeler reheat steam generator may be listed as follows:

- complete freedom from furnace slagging is assured because furnace can be designed to suit fuel characteristics rather than reheat cycle duty requirements
- permissible wider selection of fuel of varying slagging characteristics
- location of the reheater deep in the convection zone assures safer metal temperatures during all starting, shutting down, and emergency operating conditions

This design also incorporates such features as:

- complete drainability of all superheating and reheating surfaces essential to quick and normal starts
- wide range of precise control of final steam temperature
- fully independent means of controlling primary and reheat steam temperatures.

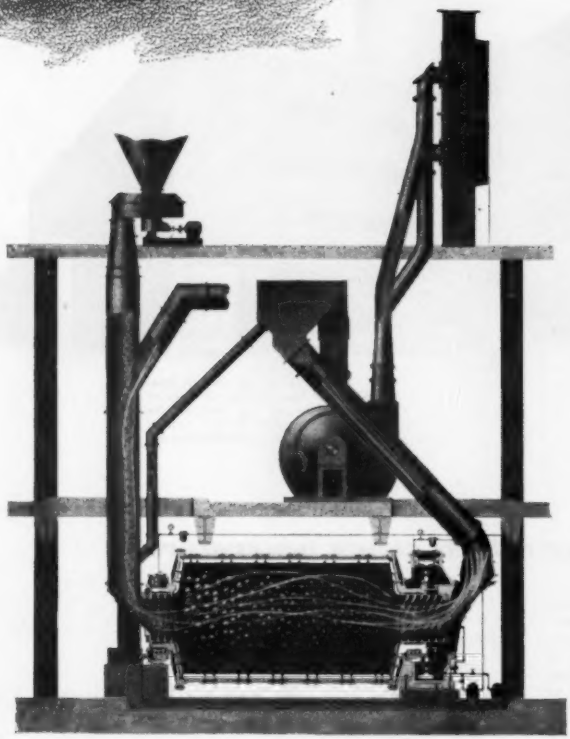
These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

UTMOST ECONOMY *and* SCARCITY *of* FUEL

prompted choice of 26 KVS



Contracts recently placed with John Thompson, Ltd. by the British Electrical Authority (B.E.A.) include 26 KVS Air Swept Tube Mills which will pulverize coal for the generation of 5,750,000 lbs. of steam per hour in John Thompson boilers. The following plants and equipment are involved:

Tilbury Power Station, London . . .
five units, each designed for 550,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.

Marchwood Power Station, London . . .
four units, each designed for 550,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.

Brimsdown Power Station, London . . .
two units, each designed for 340,000 lbs. per hr. at 950 lbs. per sq. in. and 925° F.

Pulrose Power Station, Isle-of-Man . . .
two units, each designed for 60,000 lbs. per hr. at 425 lbs. per sq. in and 775° F.

AIR SWEPT TUBE MILLS

for 4 Central Power Stations

KVS equipment was selected because economy was of prime importance and because coal was scarce and of low grade. Confidence in the ability of Kennedy Van Saun Air Swept Tube Mills to meet these rigid requirements was a determining factor in this selection.

Outstanding among the many reasons why KVS equipment is preferred in modern power plants are:

. . . unburnt carbon losses are less than half of one percent at all ratings.

. . . load changes do not affect high efficiency.

. . . up to 20% moisture evaporated in the mill.

. . . grinding balls added without shutting down.

. . . continuous, year-to-year operation; availability better than 99%.

Consult with us on your coal burning

Kennedy Products — Kennedy-Van Saun

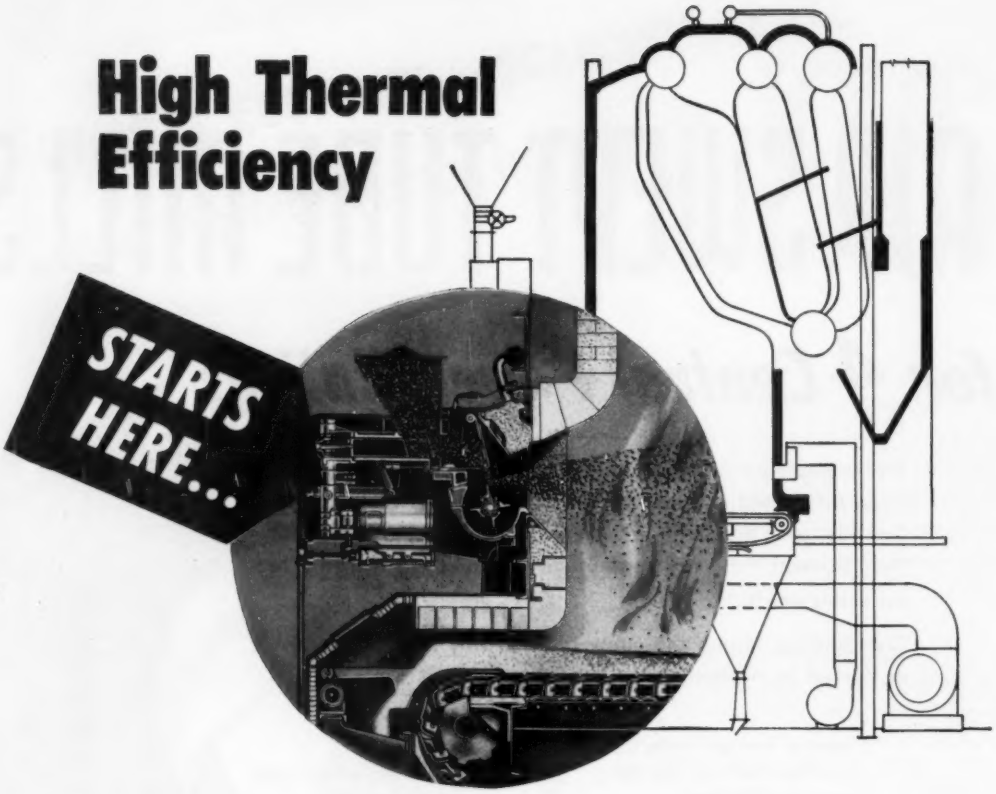
MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

High Thermal Efficiency



It pays to choose your stoker carefully!

The coal-burning efficiency of your stoker is the starting point of coal saving . . . because the coal is all burned by the stoker and the coal bill is your major operating expense.

The burning of fuel for steam generation has always been one of the most exacting jobs that a machine can be called upon to perform. A stoker must operate twenty-four hours a day, seven days a week, for periods of six months or a year without a shutdown. The interior parts are exposed to heat and corrosion, the exterior mechanism to dirt and dust. A forced shutdown of the stoker may mean curtailment of production and cost the user many times the price of the stoker.

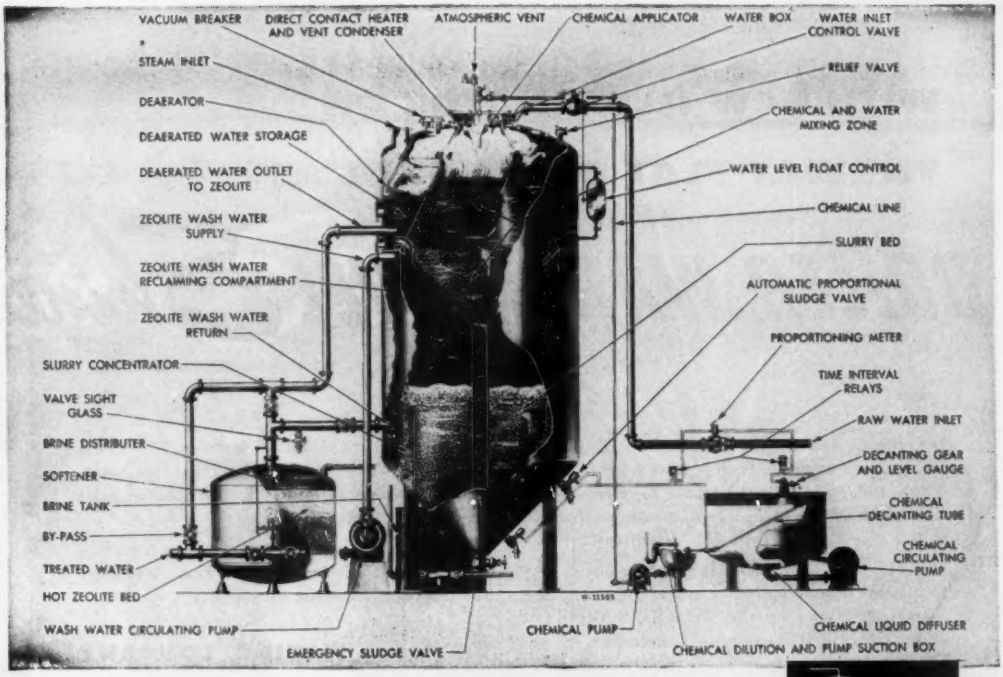
For over 60 years Westinghouse has maintained a consistently high standard of performance, while developing ever improved stokers to keep pace with the increasing demands of industry. And to make this assurance doubly sure, Westinghouse maintains a staff of experienced combustion engineers in all principal cities to make periodic inspections and give prompt attention to any operating problems.

Before you invest, be satisfied you are buying the best stoker. Westinghouse offers a complete line of underfeed and spreader stokers for use with any boiler of your choice. Capacities range from moderate to over 400,000 lbs. of steam per hour. Get the full story. Call your nearby Westinghouse office . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50525

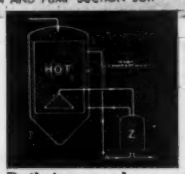
YOU CAN BE SURE...IF IT'S

Westinghouse

STOKERS



Here's how to make water softening a soft job for you



You have less to do . . . to worry about . . . to pay for—when you use Worthington's revolutionary Hot-Z Slurry-Type Deaerating Water Softener.

It combines all the best features of Hot Process and Zeolite, plus these Worthington-originated features:

No more scaling trouble. Direct-contact vent condenser eliminates scaling trouble experienced with old-fashioned shell-and-tube types.

Supervision reduced. Concentrated sludge is removed automatically and proportionately to water volume.

Assures uniformity. Hydraulic chemical mixer assures uniformity of chemical strength. Also saves space.

Easier cleaning of valve-type wash water sight glass.

Better deaeration. Steam-jet deaeration is simpler, gives better efficiency—removes oxygen to .005 cc per litre.

Independent backwash system. Built-in annular wash water compartment provides clear hot water for backwashing and reclaims it without affecting operating velocities in treating zone. This feature not only pays off in systems employing filters, but also is ideal for backwashing the hot zeolite.

You also save because Worthington Hot-Z Systems operate on low-priced lime and salt. The average installation saves enough in chemical costs to pay for itself in 3 years!

Get all the facts!

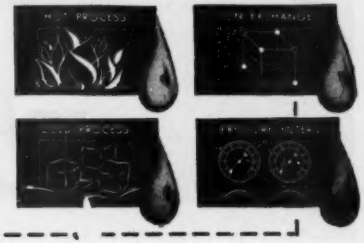
It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find *there's more worth in Worthington.* Worthington Pump and Machinery Corporation, Water Treating Section, Dunnellen, N. J.

J.1.2

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



WITH NEW ILLUMINATOR ON YARWAY FLAT GLASS GAGE...

BOILER WATER LEVEL *Shines*

It's light! It's bright! It's right! You see instantly the accurate boiler water level in your Yarway Flat Glass Gage because *the meniscus at water level stands out like a brilliant star...* thanks to the new Yarway Type "M" Illuminator.

The Type "M" Illuminator is specially-designed to give maximum brilliance to Yarway flat glass inserts, and to spot the water level over its entire traverse. The superior penetration of its blue-white light cuts through extraneous light, dust particles in the air, and deposits on the gage glasses. Effective over longer distances.

New or already-installed Yarway Flat Glass Gages may be equipped with the Illuminator. Yarway Illuminators may be installed in pairs on four-glass gages.

Get in touch with your nearest Yarway office for further details on this latest Flat Glass Gage development, or write direct to...

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

A COMPLETE YARWAY WATER LEVEL SYSTEM

YARWAY STEAM

like a Star
TYPE "M" ILLUMINATOR ATTACHED
TO FLAT GLASS GAGE INSERT
YAR
WAY
PLANT EQUIPMENT

"HOW WE USING COAL

Louis G. Natte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

To this great modern plant in Little Falls, N. J., 500 employees come every day to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers spread across a 5,000 square-mile area! The laundry can be called completely self-sufficient. It depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.

If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!

COAL in most places, is today's most economical fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

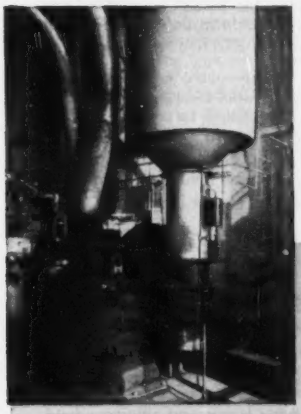
COAL is the safest fuel to store and use.

COAL is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

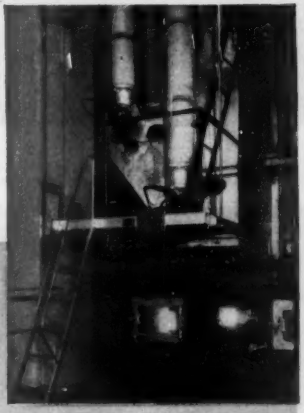
SAVE $20,000 A YEAR—INSTEAD OF OIL"

(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N. J.)

"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice —but so far we've *never* done it. Coal does a great job—cheaper."



This is the company's up-to-date pulverizer from which the ground coal is blown into the boiler. Before this final operation, the laundry employs a steel-slatted conveyor belt to feed a precrusher. From there, power-driven bucket-conveyors carry the coal to the 100-ton storage hopper which feeds the pulverizer. *Modern automatic coal devices of all kinds slash labor costs—make coal's basic economy even greater.*



This is a section of the laundry's modern coal-fired boiler installation. With modern equipment like this it is possible to add anywhere from 10% to 40% to the power derived from the same amount of coal in years past. Actually with coal-fired plants of up-to-date design many companies have brought over-all boiler efficiency up to 85% or more.

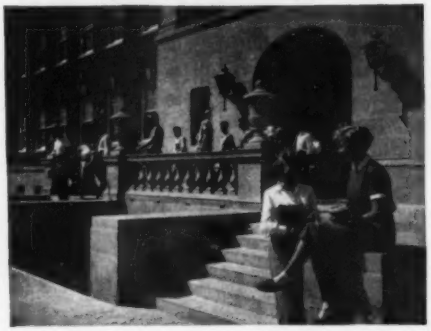
● Plants that use coal are in an enviable position —at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

To get *all* the great economy that coal can deliver—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis* . . . is your best fuel buy, by far!

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

Picture Trip!

Air view of S.M.U. campus in Dallas, Texas. One of the Southwest's finest universities, S.M.U. is also proud of such sports stars as recent football All-Americans Doak Walker and Kyle Rote.



Front entrance to Fondren Hall, new science building, which combines the dignified grace of classic architecture with latest achievements in interior design and laboratory-classroom facilities.

A DILLER, A DOLLAR, AN Air Conditioned

• • • what makes you come so soon?

At Southern Methodist University, it's the prospect of cool, freshened classrooms . . . beyond the reach of Dallas' sometimes-100-degree heat. No sweltering, no stuffiness.

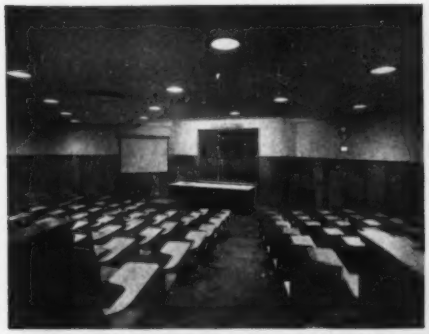
This air conditioning system at S.M.U. rates straight-A with students and faculty. Its pleasant, proper cooling reduces fatigue, promotes individual concentration, heightens interest . . . all vitally important to effective education and training.

Backbone of this system, behind the scenes, is the equipment contained in it. Large centrifugal refrigeration compressors chill and dehumidify the air to be circulated. The big motor driving this type of compressor must be especially suited to the job . . . for this, the new heavy-duty, variable speed E-M Wound-Rotor Induction Motor is a natural!

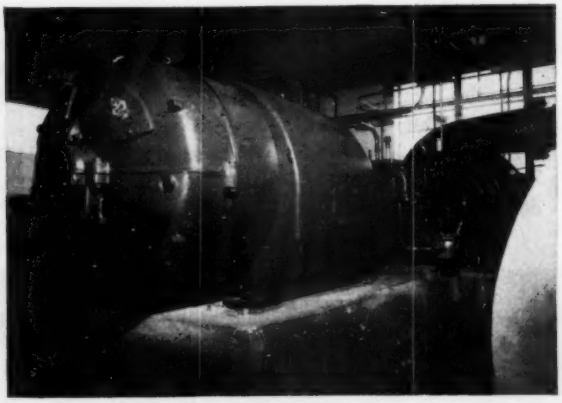
E-M VARIABLE SPEED DRIVE CUTS COSTS . . . ALLOWS ADJUSTMENT FOR MOST ECONOMICAL OUTPUT

Here's a point that will interest you. The load characteristics of a centrifugal refrigeration compressor enable you to drastically reduce compressor output with only a small reduction in motor speed. In this load and speed reduction, the losses in the motor are not unduly large. Hence, the compressor output can be adjusted over a wide range, and efficiency held to a maximum for greatest savings in power cost.

Another advantage of this Wound-Rotor Motor is its ability to start in small increments with very low current inrush. This minimum starting current avoids sharp voltage dips which might cause objectionable light flicker or possibly drop out other equipment on the line.



A lecture room in Fondren Hall—one of the many S.M.U. buildings air conditioned throughout for comfortable, productive work and study. E-M Motor at right plays a big part in this air conditioning program.



Scholar...

• • • what's in it for *you?*

Picture these E-M Wound-Rotor advantages at work for you . . . flexible drive power enabling you to control speed, torque, and starting current:

High starting torque and low starting current if required . . . valuable for hard-to-start loads.

Suitable heat dissipation through long acceleration periods . . . an asset when starting high inertia loads.

Cushioning for high intermittent load peaks . . . often advantageous on chipper or crusher drives.

Continuous operation at reduced speed . . . just the thing for regulating output on centrifugal pumps, compressors, and fans.

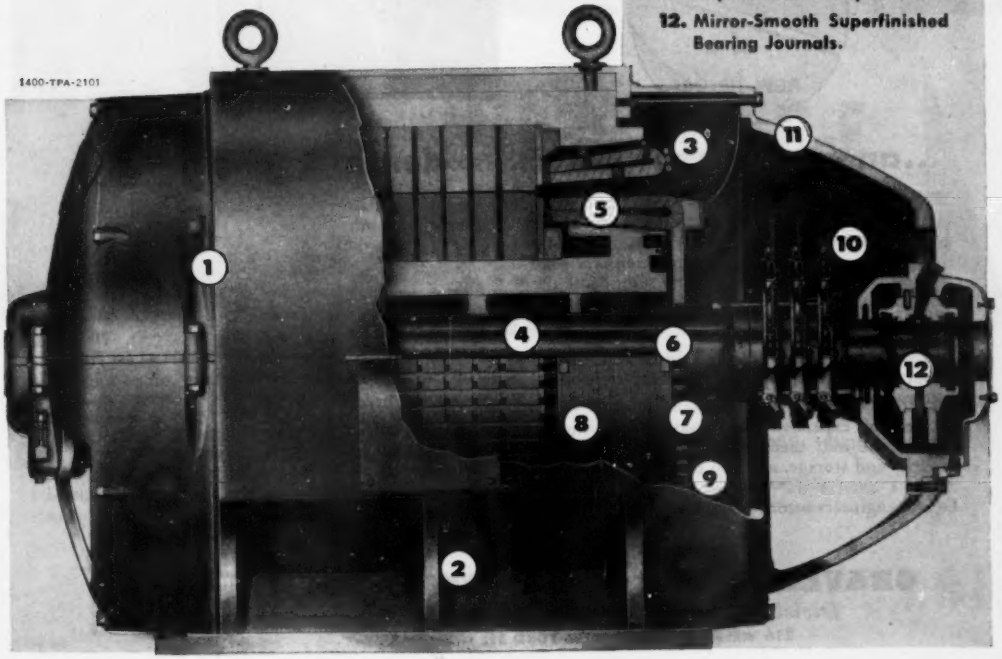
Can you use some of these outstanding E-M benefits on your application? Why not find out . . . ask your nearest E-M sales engineer. E-M publication No. 198 will also interest you. Write the factory and ask for it.

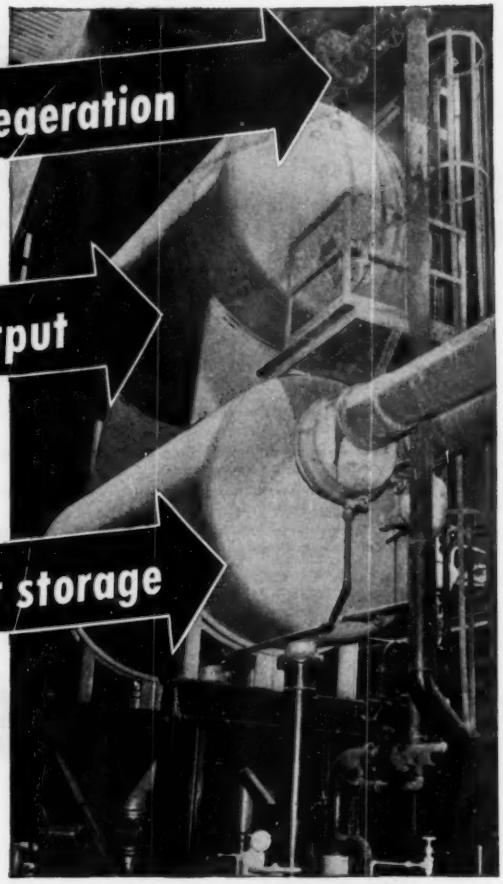
ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

12 BIG FEATURES

DESIGNED BY ENGINEERS WHO KNOW WHAT YOU WANT IN BIG MOTORS:

1. **Drip Protection Sheds Liquid and Dirt.**
2. **Sturdy Steel Frame Can't Crack.**
3. **Long Life Stator Coils Tightly Braced.**
4. **Strongly Built Rotor.**
5. **Pre-Formed, Pre-Insulated Rotor Coils.**
6. **Precision Balance . . . Smooth Running.**
7. **Silver Brazed Coil Connections.**
8. **Stainless Steel Banded Coil-Ends.**
9. **Proper Ventilation with Copper Fin Blowers.**
10. **Uniform Brush Pressure Adjuster.**
11. **Easy Access to Brushes for Inspection and Replacement.**
12. **Mirror-Smooth Superfinished Bearing Journals.**





83⅓% greater deaeration

60% more heater output

400% extra hot water storage

at ½ the cost of a new heater

...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

GW 487

Ready for today's great power expansion

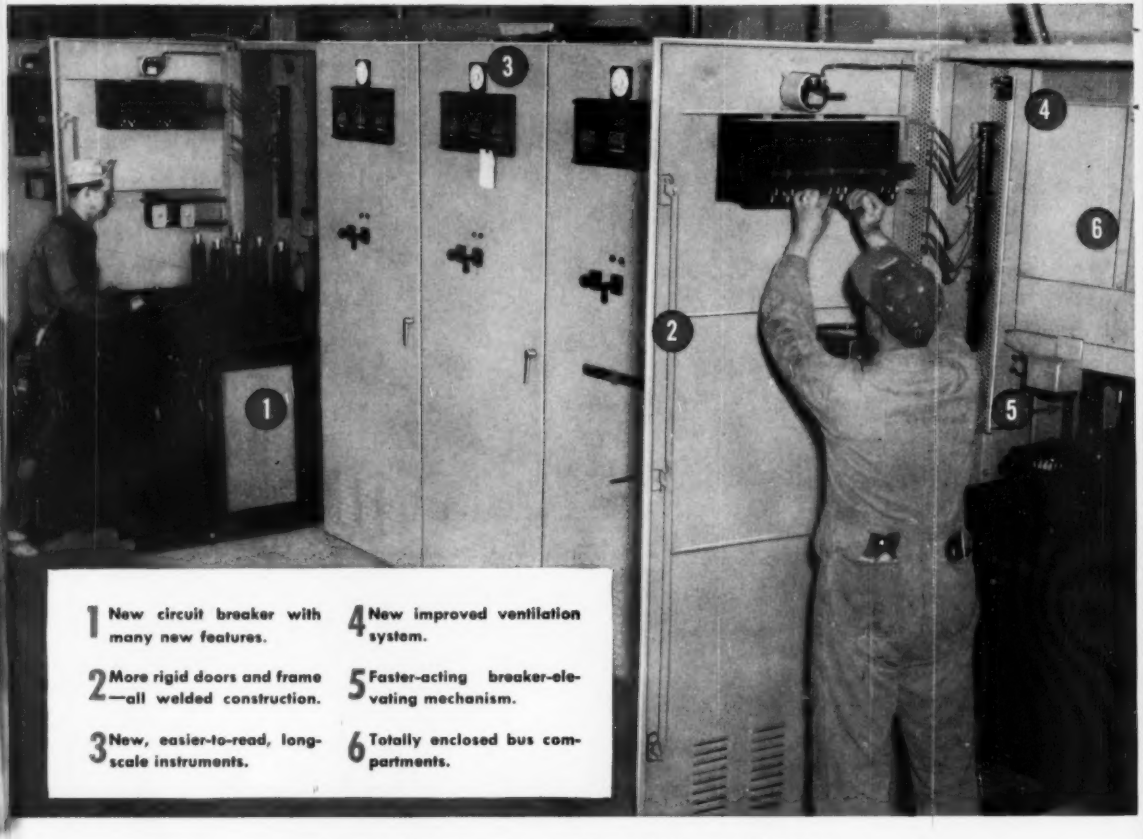
IMPROVED G-E METAL-CLAD SWITCHGEAR

...matched to today's greater "on the job" requirements, and meeting all industry standards.

Already delivered to one of America's largest and newest industrial plants, this improved G-E Metal-clad Switchgear will assure dependable power for a mammoth production job. In the foreground are the 13.8-kv G-E magne-blast circuit breakers for the Metal-clad equipments being installed.

GENERAL ELECTRIC

Improved G-E Metal-clad Switchgear


1 New circuit breaker with many new features.
2 More rigid doors and frame—all welded construction.
3 New, easier-to-read, long-scale instruments.
4 New improved ventilation system.
5 Faster-acting breaker-elevating mechanism.
6 Totally enclosed bus compartments.

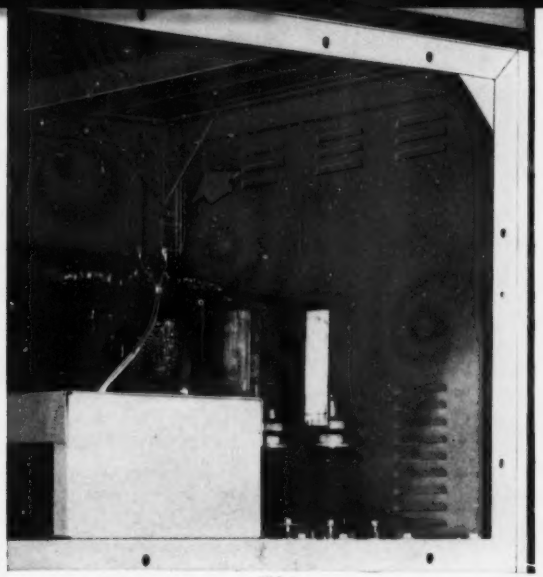
Stronger! Safer! A Wealth of New Features That Contribute to More Dependable Operation!

Pioneered by General Electric in 1935, Metal-clad Switchgear has set new standards of safety and dependability that have made it the accepted power distribution equipment throughout all industry.

Now, with new pace-setting advances in design and construction, it's better than ever, and still maintains the features of visible primary contacts when breaker is lowered to the disconnect position.

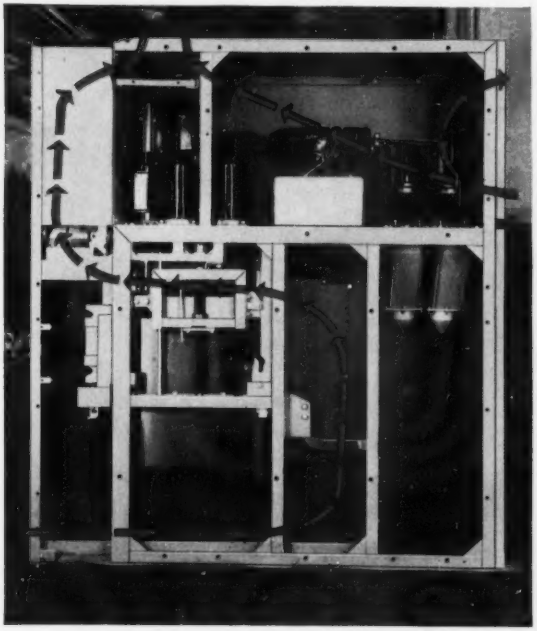
With expanding production schedules calling for more and more electric power, improved G-E Metal-clad Switchgear, in 4.16 kv and 13.8 kv ratings, gives the greatest protection against electrical shut-downs. New advanced features simplify operation and inspection, and provide increased safety for personnel. And with stronger, more rigid construction and simplified design of many components, you get even more dependability.

Only a few of the many new features can be shown here. For full information, see your local G-E Apparatus Sales representative, or write for Bulletin GEA-5664, General Electric Company, Schenectady 5, N. Y.

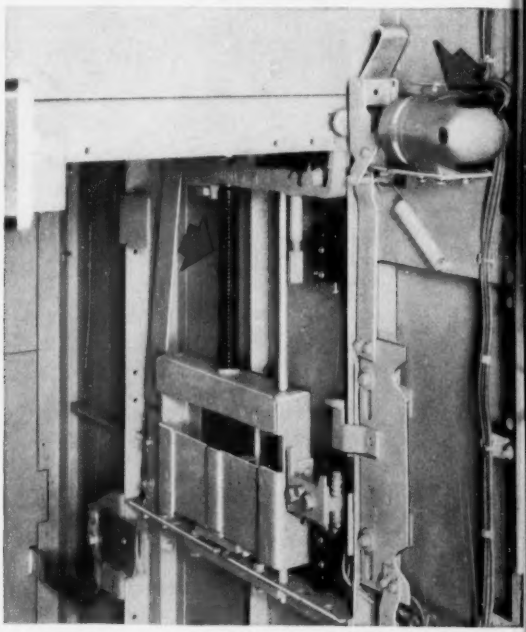


FRAME NOW COMPLETELY WELDED into one solid unit. Gusseted corners (see arrow) provide greater rigidity. Doors have a three-point latch operated from a single handle, and are reinforced against warping by a steel tube at hinge side.

REMOVABLE MAGNE-BLAST CIRCUIT BREAKER features improved flame-retardant insulation and simplified contact design. Breaker operating mechanism and control relay are on the front of breaker for easy accessibility.

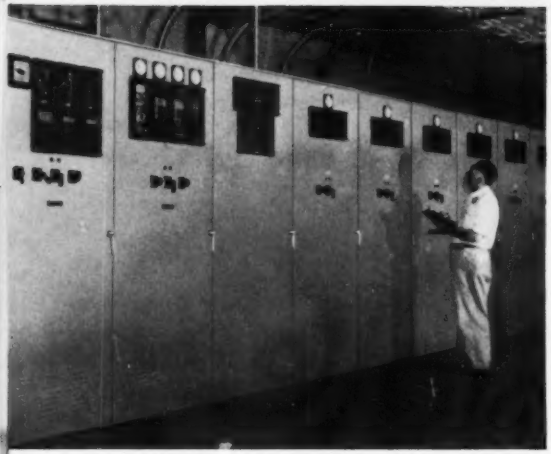


IMPROVED VENTILATING SYSTEM: Arrows show natural draft of air that constantly ventilates entire switchgear unit. The totally enclosed bus compartment, at upper left, is cooled by the circulation of air around it.

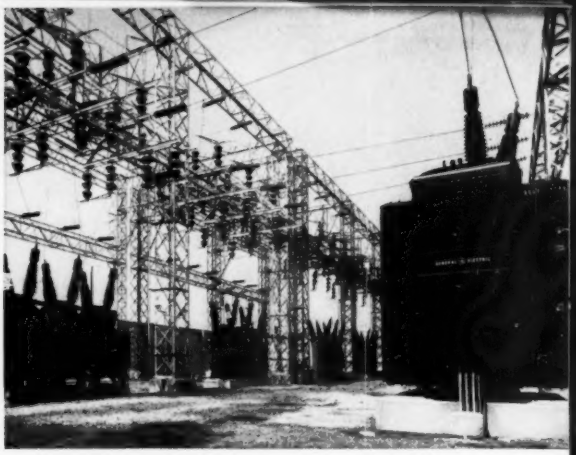


NEW FASTER ACTING BREAKER ELEVATING MECHANISM can raise the removable circuit breaker into position, or lower it for testing, in 30 seconds. A new compact gear-motor drives the simplified jack screw elevating mechanism.

GENERAL ELECTRIC



IMPROVED G-E METAL-CLAD SWITCHGEAR shown installed in new plant. Adequate interrupting capacity of circuit breakers plus total enclosure of all live parts insures maximum protection against electrical failures.



G-E OUTDOOR SUBSTATION built from standardized units, including transformer, oil circuit breakers and steel structure. Use of this equipment enabled this plant to save months in planning and installation.

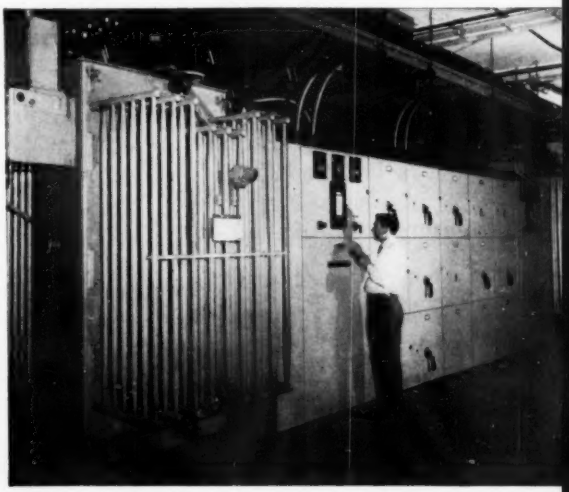
Complete Electrical System from "Packaged" equipment

...Here's the modern trend made possible with G-E equipment

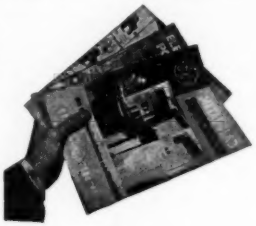
General Electric Vertical-lift Metal-clad Switchgear is only one item in a complete line of factory-assembled "packaged" equipment designed to simplify planning and speed installation of the safe, modern electrical systems required for today's expanding production.

The trend to "packaged" electrical equipment throughout the installation is illustrated by the examples shown on this page. Installed in one of the nation's newest and largest plants, each item of equipment was supplied as a ready-to-use unit. Use of standardized "packaged" equipment enabled this plant to get into production in record time.

Perhaps similar equipment can help you. General Electric engineers stand ready to assist you in solving your particular problems. General Electric Co., Schenectady 5, N. Y.



METAL-ENCLOSED LOAD-CENTER UNIT SUBSTATION, delivered as a "package," supplies low-voltage power to adjacent machines—eliminates need for long, low-voltage feeder system. Unit shown is one of 18 installed in this plant.



Complete data at your finger tips—Write for these helpful bulletins

Full information on modernizing or expanding your electrical system with G-E packaged equipment is given in these three illustrated booklets. Write for GEA-5664 "G-E Metal-clad Switchgear," GEA-3592 "Load-center Unit Substations" and GEA-5600 "Power for Industry's Third and Biggest Expansion."

GENERAL ELECTRIC

854-42

Popular Choice!

SPRINGFIELD TYPE C *Standardized* 2-Drum Boilers

Across the country, leading industrial plants have made Springfield Type C 2-Drum Boilers THE POPULAR CHOICE where steam is needed for power, process, or heating service! Because these advanced designs are produced in a wide range of *standard* sizes, delivery time and engineering costs are held to a minimum. Users get many advantages: Positive Circulation...High Reliability...Water Cooled Furnace...Dry Steam—steam delivery tubes discharge above water level...AND *good efficiency with any type of fuel you want to burn!* Superheater, economizer, and air heater, if desired. For quotations and information, see your local Springfield representative or write us TODAY.

CEREAL MAKER—30,000 lb. Springfield Type C unit for America's largest manufacturer of cereals and grain food products. Oil and gas fired. *Location: Belmond, Iowa.*

LUMBER MILL—Two 65,000 lb. Springfield Type C units for large West Coast lumber company. Designed for firing with wood waste. *Location: Gardiner, Oregon.*

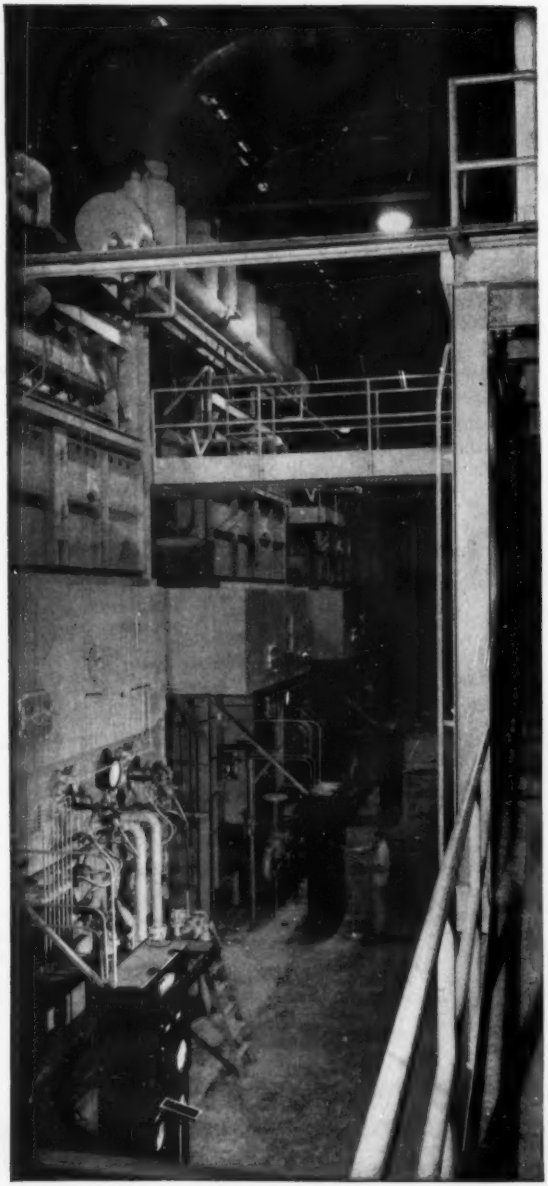
INSULATING MATERIALS 50,000 lb. Springfield Type C unit for insulation maker. Spreader stoker firing. Operating pressure, 250 psi. *Location: Dubuque, Iowa.*

BUILDING MATERIALS—30,000 lb. Springfield Type C unit for well-known maker of pressed sheathing and board. Gas and oil firing to 450 psi. *Location: Los Angeles, California.*

PLYWOOD PLANT—30,000 lb. Springfield Type C unit for western plywood mill. Designed for firing with wood waste. *Location: Portland, Oregon.*

STEEL MILL—35,000 lb. Springfield Type C unit for maker of steel forgings. Spreader stoker firing. Operating pressure 160. psi. *Location: Gary, Indiana.*

COMBUSTION CONTROL



FOR
ALL SIZES OF BOILERS
ALL TYPES OF FIRING
ALL LOAD CONDITIONS

An automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

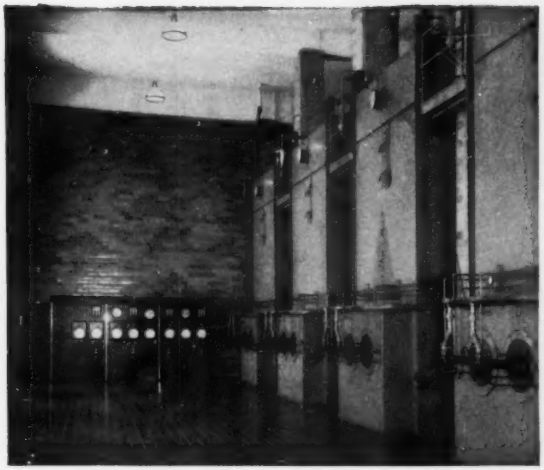
Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler.

It automatically increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

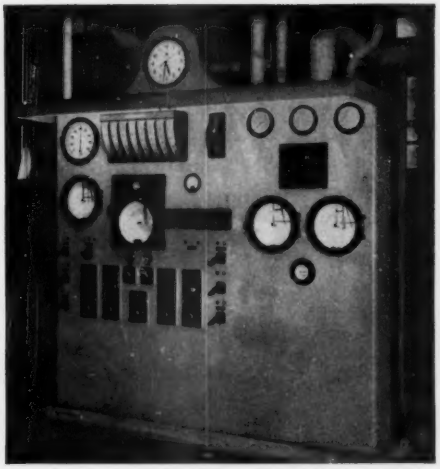
Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.

GAS FIRED—In this modern industrial plant steam is generated at the rate of 400,000 lbs. per hr. by four gas fired boilers operated by a Republic automatic combustion control system.

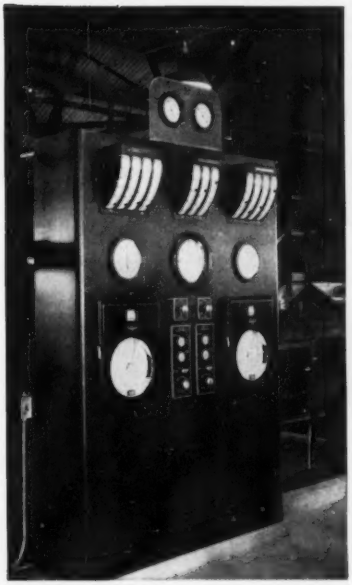
STOKER FIRED—The Republic instrument and combustion control panel for an 80,000 lbs. per hr., stoker fired boiler in a municipal power plant.



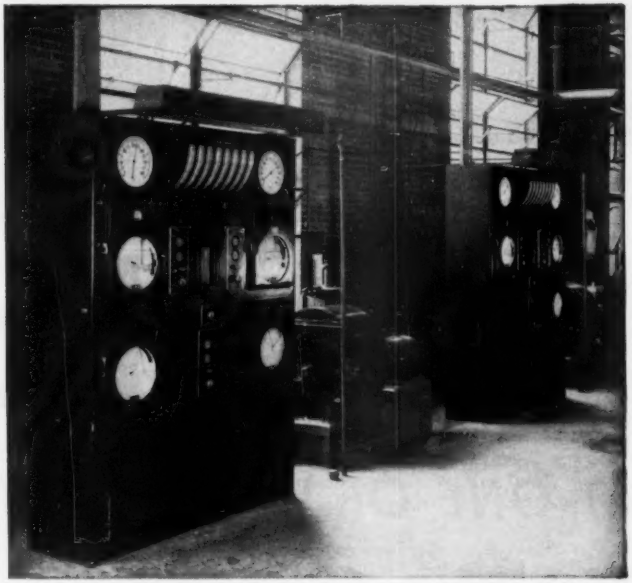
OIL AND GAS FIRED—In this model boiler room of a large institution the four combination oil and gas fired boilers are operated by a Republic automatic combustion control system.



STOKER FIRED—The Republic combustion control and instrument panel for the automatic operation of a 45,000 lbs. per hr. stoker fired boiler.



MIXED GAS—Republic instrument and control panel installed in a natural gasoline plant to automatically control two 50,000 lbs. per hr. boilers burning mixed gas.



STOKER FIRED—A typical Republic combustion control installation in the boiler room of a mid-western university for the automatic operation of two 25,000 lbs. per hr. stoker fired boilers. All boiler instruments and manual controls are centralized on the two panels pictured above.

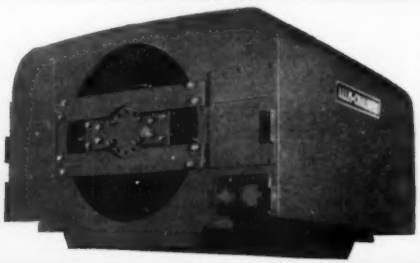
REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

WA-Series

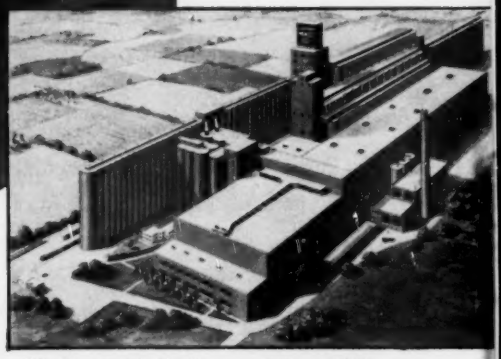
STEAM TURBINE GENERATOR UNIT

Doing Double

AT ONE OF WORLD'S LARGEST MALT



SIMPLIFYING INSTALLATION, both turbine and generator (shown at left) are shipped as complete assemblies with the rotors locked in place. The WA-Series generator is of the housing type with air-coolers mounted in the stator above the floor lines, eliminating special coolers and duct work.



Ladish Malting Co. Uses Steam for both Processing and Power Generation

Duty

HOUSES!

GREAT QUANTITIES OF STEAM are required in the process of manufacturing 10 million bushels of malt annually at the Ladish Malting Co., Jefferson Junction, Wisconsin. And, as an economic by-product, the electric power needed for plant operation is generated by the same steam.

When this world's largest single unit malt house recently needed more generating capacity, Allis-Chalmers again was chosen. And with good reason, since two Allis-Chalmers units had been supplying the electric power consumed at the Ladish Malting Company for nearly fifteen years.

Installed in 1951, the modern 2500 kw WA-Series unit shown here is now on 24 hr a day, 7 day a week duty. It consists of a non-condensing impulse steam turbine and housing type air-cooled generator and exciter . . . carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA ratings through 7500 kw, a modern WA-Series unit also will enable *your* power plant to meet tomorrow's expanded power demand. Complete details contained in new Bulletin 03B7654. For your copy, just call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3601

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

POTOMAC RIVER GENERATING STATION
Potomac Electric Power Company

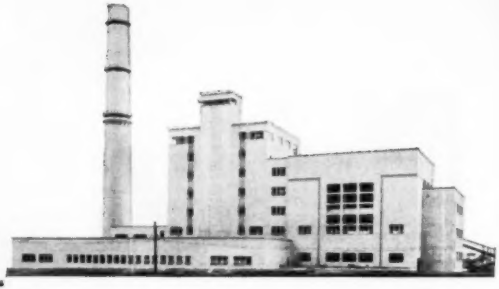
In November 1951 the Federal Power Commission released a report entitled "Steam-Electric Plant Construction Cost and Annual Production Expenses for 1950."

Among other interesting and significant data were the "Average Btu per Kilowatt-hour Net Generation" of 264 power stations reporting from all sections of the country. Seven of the ten steam-electric stations having the *lowest* annual heat rates — as revealed by the report — are pictured on these pages.

All of the steam generating equipment in these seven stations was designed and built by Combustion Engineering — Superheater, Inc.

B-546

7 of



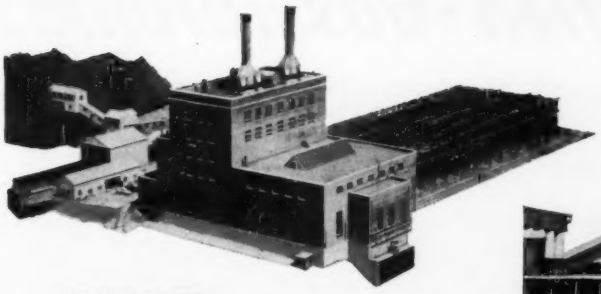
RUSSELL STATION
Rochester Gas & Electric Corporation

PORT JEFFERSON STATION
Long Island Lighting Company

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

PORT WASHINGTON STATION
Wisconsin Electric Power Company



DAN RIVER STATION
Duke Power Company

the top 10

O. H. HUTCHINGS STATION
The Dayton Power and Light Company

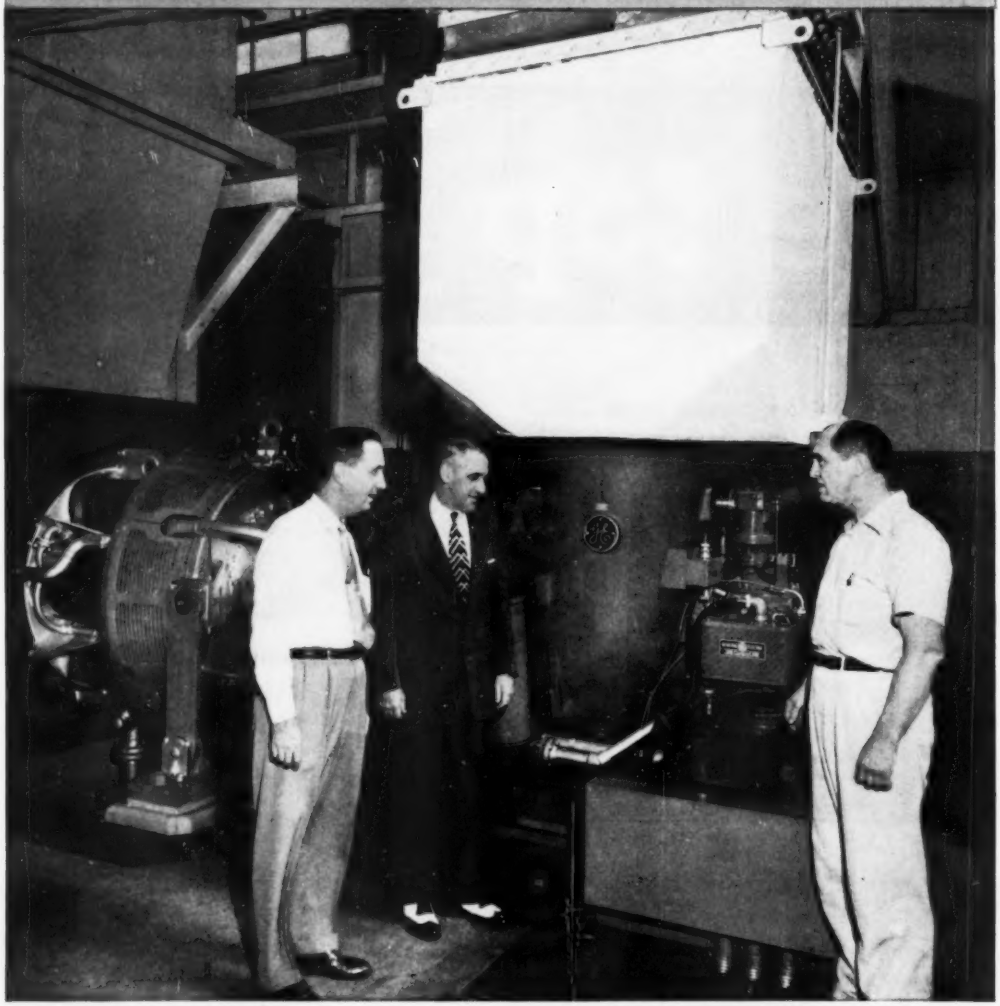
SEWAREN GENERATING STATION
Public Service Electric and Gas Company

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.
C-E

Combustion-Gas-Turbine

Total Installed Hours	17,604
Hours in Service	15,241
Total Power Produced in KWH	66,465,000
Average Load	4361 KW
Hours Scheduled Out	2326
Hours Forced Out	37
Unit Capacity Factor	124.6%

*A duplicate unit has just been ordered for installation in this station.



Donald S. Kennedy, President of Oklahoma Gas and Electric, inspects the 3500-kw combustion-gas-turbine at the Belle Isle Station with C. C. Willis (extreme left) Superintendent of Generation at O.G. & E. and G. D. Conley (extreme right), Chief Engineer at Belle Isle Station.

*completes 2 years at Belle Isle**

"Surpassed Expectations" says Donald S. Kennedy, President of Oklahoma Gas and Electric.

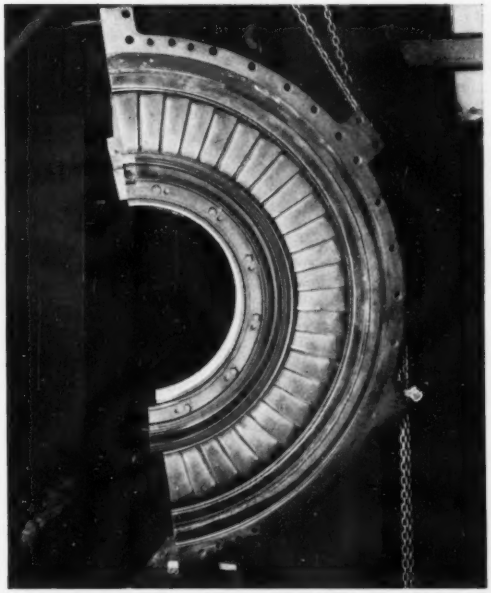
The first combustion-gas-turbine to be placed in commercial service in America has completed its second year of successful operation at the Belle Isle Station of the Oklahoma Gas and Electric Company. On the line since July 29, 1949, the 3500 kw unit has established a record which has surpassed contract commitments for both capacity and economy.

Donald S. Kennedy, President of the Oklahoma Gas and Electric Company, hailed the unit as eminently successful. "The combustion-gas-turbine at Belle Isle has been easily operated and maintained by our regular plant personnel. Maintenance costs have been lower and kilowatt output higher than we had anticipated. The output has averaged well over 100 per cent. Availability has been consistently high with only thirty-seven hours forced outage, due largely to the failure of a lube oil pump impeller. For availability, economy, and capacity, our gas-turbine has surpassed expectations."

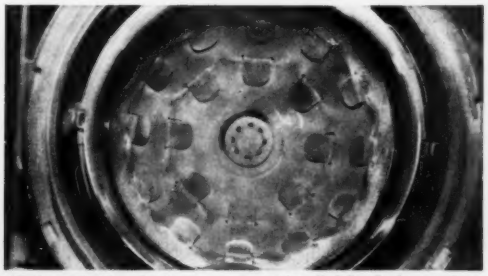
General Electric combustion-gas-turbines are available in both 3500 kw and 5000 kw ratings. For complete details call your nearest G-E sales office or write for Bulletin GEA-5516, "Gas Turbine Power Plants." General Electric Company, Schenectady 5, New York.

11,823-HOUR INSPECTION REVEALS EXCELLENT OPERATING CONDITION

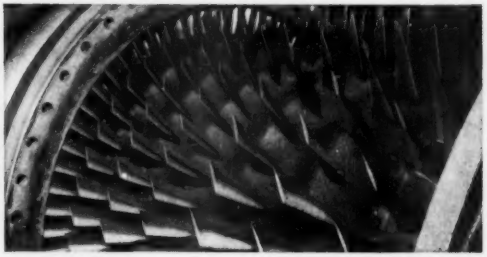
A routine semi-annual inspection of the Belle Isle gas turbine was held in March, 1951. This careful check-up on all original parts failed to uncover any major components —either rotating or combustion—which required replacement.



This half-section of the second-stage nozzle diaphragm had undergone almost no deterioration in twenty months of service. Its condition, typical of all diaphragm pieces, warranted no maintenance.



All six combustion chamber caps were reinstalled for further service. The discoloration around the gas fuel nozzle of this cap is a deposit of noncombustible residue from the fuel.



The compressor rotor, shown here with the top half of the casing removed, had collected a slight amount of dirt but was otherwise in original condition.

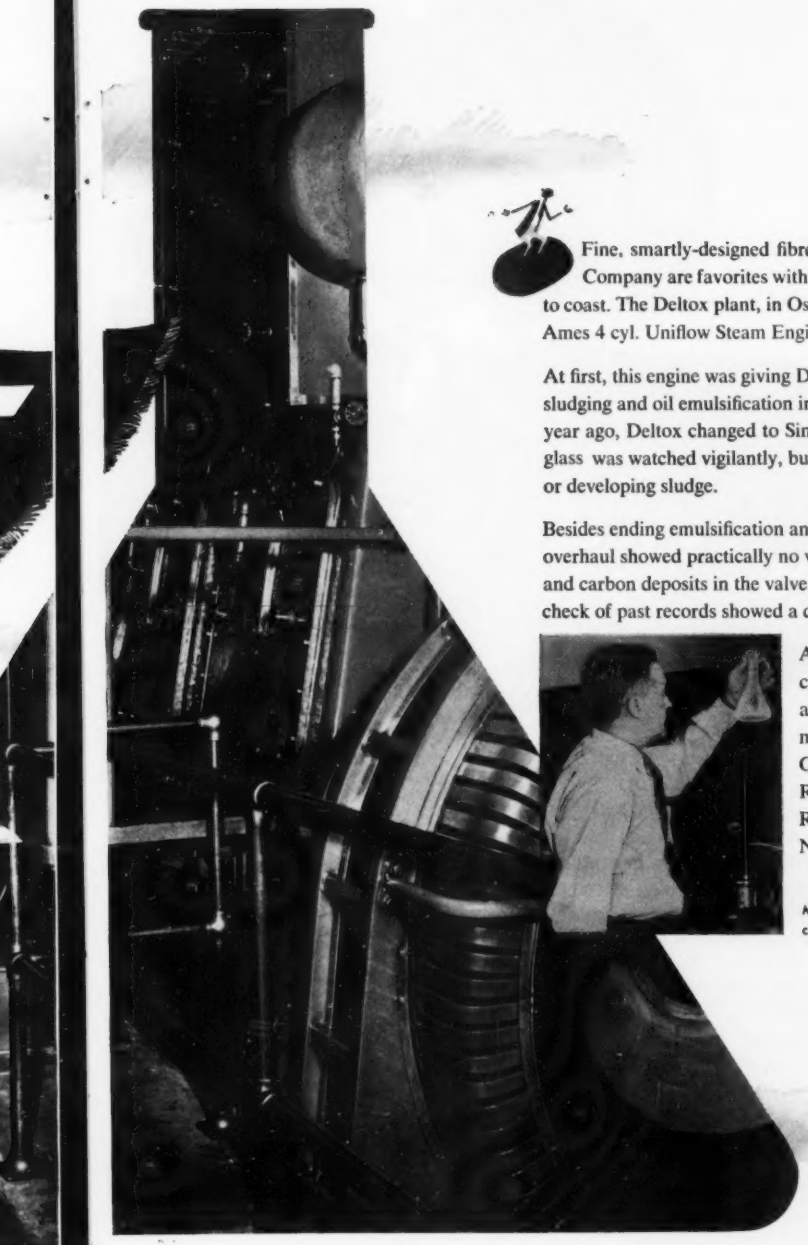
GENERAL ELECTRIC

255-5

"Make-Up Oil Cut 19%"

— says Deltox Rug Co., Oshkosh, Wis.

SINCLAIR OILS



Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4 cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

Are you getting full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

for circulating systems

Two years ago, Foster Wheeler had 19 condensers serving turbo-generators of 100,000 kw and larger.

NOW THE TOTAL IS 57 CONDENSERS.

These serve turbo-generators of 100,000 kw and larger in steam-electric stations at locations indicated on the map. They are engineered to meet the requirements of different geographical locations and varying water conditions.

The "wide open" design of the Foster Wheeler cross-flow and double-flow condensers makes them especially adaptable for handling large steam volumes from units of this size.

We are especially proud of the number of repeat orders testifying to the superior performance of Foster Wheeler condensers.

1. Super Power Company of Illinois (Powerton Station)
   2 units — operating — 108,000 kw each
2. Philadelphia Electric Company (Southwark Station)
   2 units — operating — 165,000 kw each
3. Kansas City Light & Power Company (Hawthorn Station)
   1 unit — building — 100,000 kw
4. American Gas & Electric for Ohio Power Company (Tidd Station)
   1 unit — operating — 100,000 kw
5. Union D'Electricite (Gonvilliers Power Station)
   1 unit — operating — 100,000 kw
6. Alabama Power Company (Gorgas Station)
   2 units — operating — 100,000 kw each
7. Alabama Power Company (Barry Station)
   2 units — building — 112,500 kw each
8. Georgia Power (Plant Yates)
   3 units — operating — 100,000 kw each
9. Tennessee Valley Authority (Widows Creek Steam Plant)
   6 units — building — 112,500 kw each

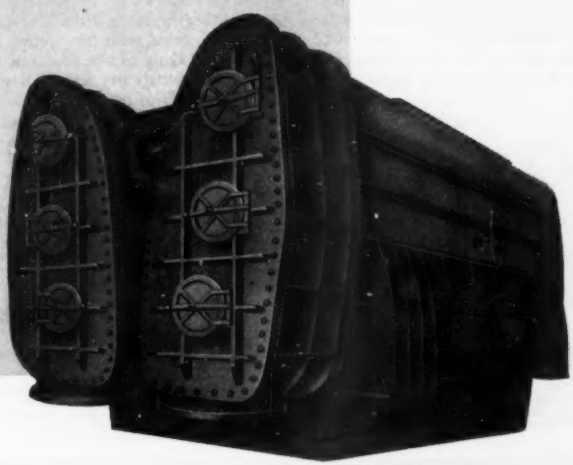
FOSTER WHEELER CORPORATION 165 BROADWAY,

in two years

57 FOSTER WHEELER CONDENSERS

are serving units of 100,000 kw and larger—

10. Tennessee Valley Authority (Shawnee Steam Plant) — 4 units — building — 150,000 kw each
11. Tennessee Valley Authority (Colbert Station) — 2 units — building — 200,000 kw each
12. Public Service Electric & Gas Co. of N. J. (Marion Station) — 1 unit — operating — 125,000 kw
13. Public Service Electric & Gas Co. of N. J. (Sewaren Station) — 4 units — operating — 125,000 kw each
14. Public Service Electric & Gas Co. of N. J. (Kearny Station) — 2 units — building — 145,000 kw each
15. Pacific Gas & Electric Company (Station "P") — 2 units — operating — 100,000 kw each
16. Pacific Gas & Electric Company (Moss Landing Station) — 3 units — operating — 100,000 kw each
17. Pacific Gas & Electric Company (Moss Landing Station) — 2 units — building — 125,000 kw each
18. Pacific Gas & Electric Company (Contra Costa Station) — 2 units — building — 125,000 kw each
19. Pacific Gas & Electric Company (Pittsburg Plant) — 4 units — building — 125,000 kw each
20. Arkansas Power & Light Company (Cecil Lynch Station) — 1 unit — building — 125,000 kw
21. Arkansas Power & Light Company (Harvey Couch Station) — 1 unit — building — 125,000 kw
22. Public Service Company of Indiana (Wabash Station) — 4 units — building — 100,000 kw each
23. Consumers Power Company (Weadock Station) — 1 unit — building — 135,000 kw
24. Dallas Power & Light Company (Parkdale Station) — 1 unit — building — 100,000 kw
25. Texas Power & Light Company (Sandow Plant) — 3 units — building — 100,000 kw each



F W Single-pass, cross flow condenser

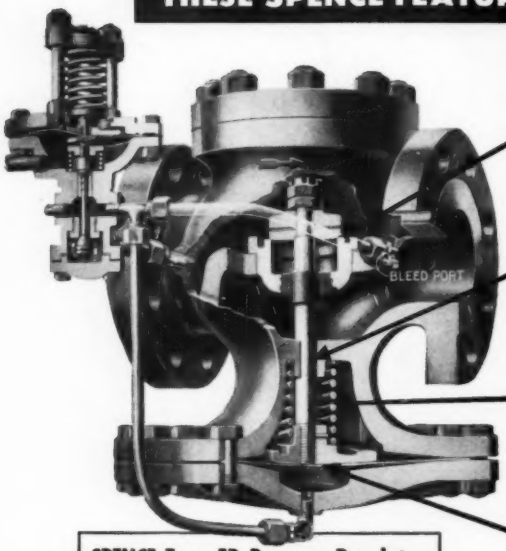
NEW YORK 6, N. Y.

FOSTER WHEELER

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

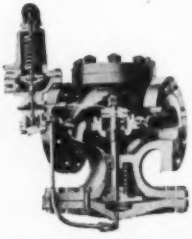
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

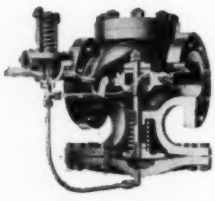
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

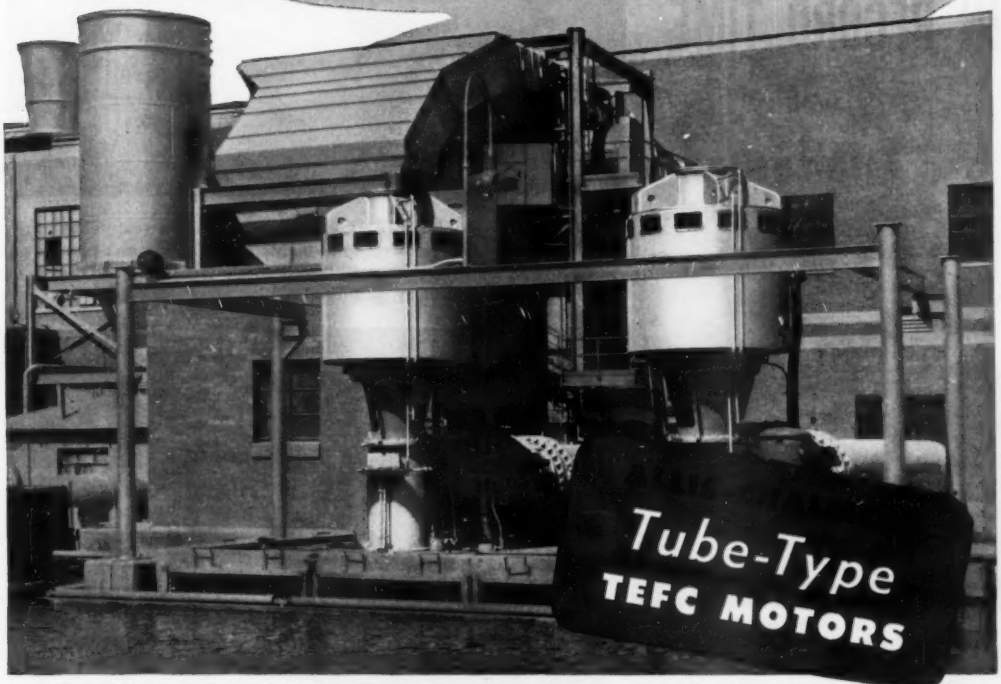
The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

Open Sky
IS ALL THE ROOF THEY NEED



● Southwestern Public Service Corporation's installation of Allis-Chalmers 400-hp, 870-rpm vertical *tube-type* TEFC motors driving Allis-Chalmers pumps at Amarillo, Texas.

What does it cost to house a motor? Nothing — if it's an Allis-Chalmers *tube-type* totally-enclosed fan-cooled motor. Then the sky is roof enough. And it need not be blue sky either.

These motors aren't afraid of fog, rain, snow, salt, coal dust, soot, alkalies, or mild acids in the air. They're built to take care of themselves . . . and to save you money. The opportunity for low installation cost is only the beginning. Peak reliability and low maintenance pay worth-while dividends throughout the long life of the motors.

Why? Because their *tube-type* air-to-air heat exchanger design offers you these advantages:

1. *Self-cleaning action* . . . result of generous flow of outside air through smooth, straight cooling tubes.
2. *Complete enclosure* . . . protects stator core and other electrical parts from dirt and corrosion.
3. *Full internal air circulation* . . . provides efficient, even cooling—makes large sizes practical.

These are proved advantages, for purchases have exceeded 170,000 hp in sizes from 250 to 2500 hp. Introduced in 1946, *tube-type* motors are now available down to 40 hp at 600 rpm.

Bulletin 05B7150 describes these motors that are equally at home indoors or out. Call your A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3534

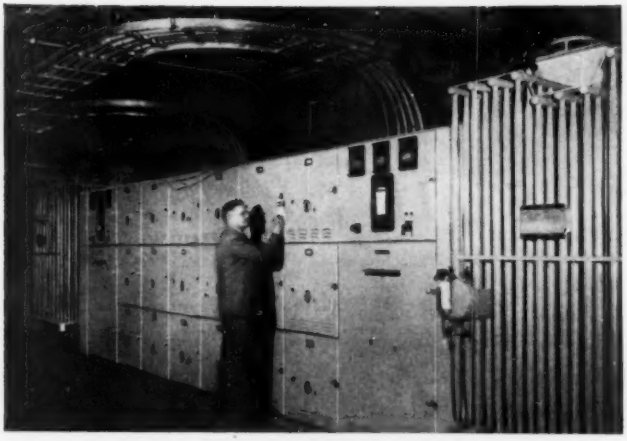
Also available in horizontal designs.

ALLIS-CHALMERS

TANK PLANT GETS ROLLING IN RECORD TIME

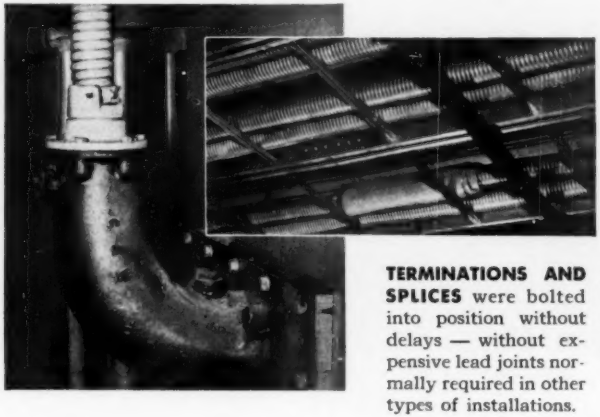
... with

G-E Interlocked Armor Cable

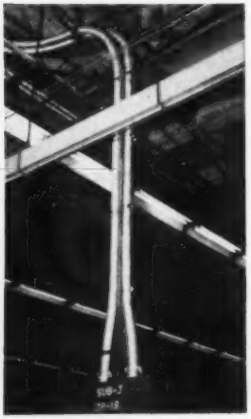


FROM WAREHOUSE TO TANK PLANT in less than a year. That's the latest record of this midwest tank plant. This 53-acre tank plant was sped into production with flexible, adaptable G-E interlocked armor cable installed on Stacey aluminum racks.

INSTALLATION SPEED was a real advantage on main-feeder runs. Racks were quickly hung from ceiling and cables were pulled into place. There was no need to fit raceways and pull cables through.



TERMINATIONS AND SPLICES were bolted into position without delays — without expensive lead joints normally required in other types of installations.



NO THREADING, NO PRE-BENDING required on this run. Hours of bending time were saved on this secondary circuit. Threading and fitting at panel box were eliminated.

COMPLETE DATA ON ADVANTAGES

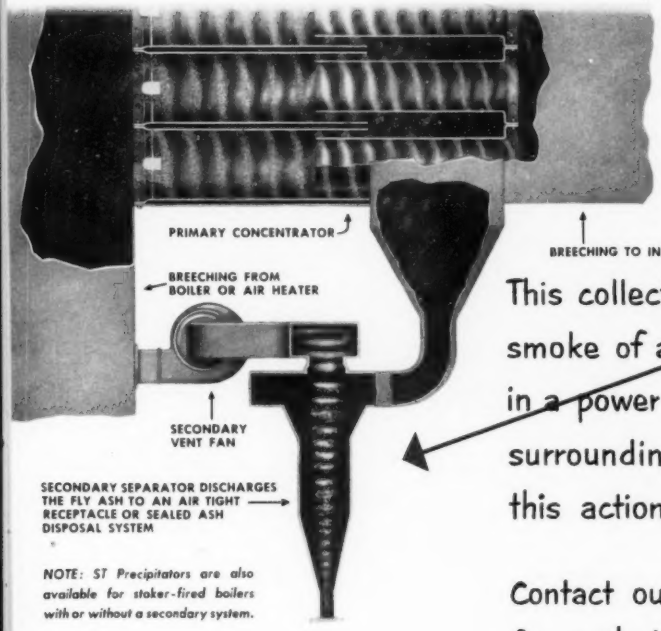
Get the story on installation speed with G-E interlocked armor cables from booklet 19-320. Write Section W11-263, Construction Materials Division, General Electric Company, Bridgeport 2, Conn.

You can put your confidence in—

GENERAL ELECTRIC

American Blower . . . a time-honored name in air handling

This collects the "goo" from the smoke in a pipe. The individual benefits by this action.


PRIMARY CONCENTRATOR
BREECHING FROM BOILER OR AIR HEATER
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM
BREECHING TO INDUCED DRAFT FAN

NOTE: ST Precipitators are also available for stoker-fired boilers with or without a secondary system.

This collects the fly ash from the smoke of a pulverized fuel-fired boiler in a power plant. The entire surrounding area benefits by this action.

Contact our nearest branch office for technical data on Type ST Fly Ash Precipitators.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

American Blower main plant and office, Dearborn, Mich. Here are located the finest research and sound laboratories and engineering facilities in the industry.

American Blower Columbus Plant, Marion Township, Ohio

You will find, in these modern plants, every facility for research, testing and manufacturing Mechanical Draft Equipment, Dust Precipitators and Gyrol Fluid Drives for power plants, as well as for the manufacture of a complete line of Air Handling Equipment for industrial and commercial needs. You are cordially invited to visit our plants and inspect our modern facilities.

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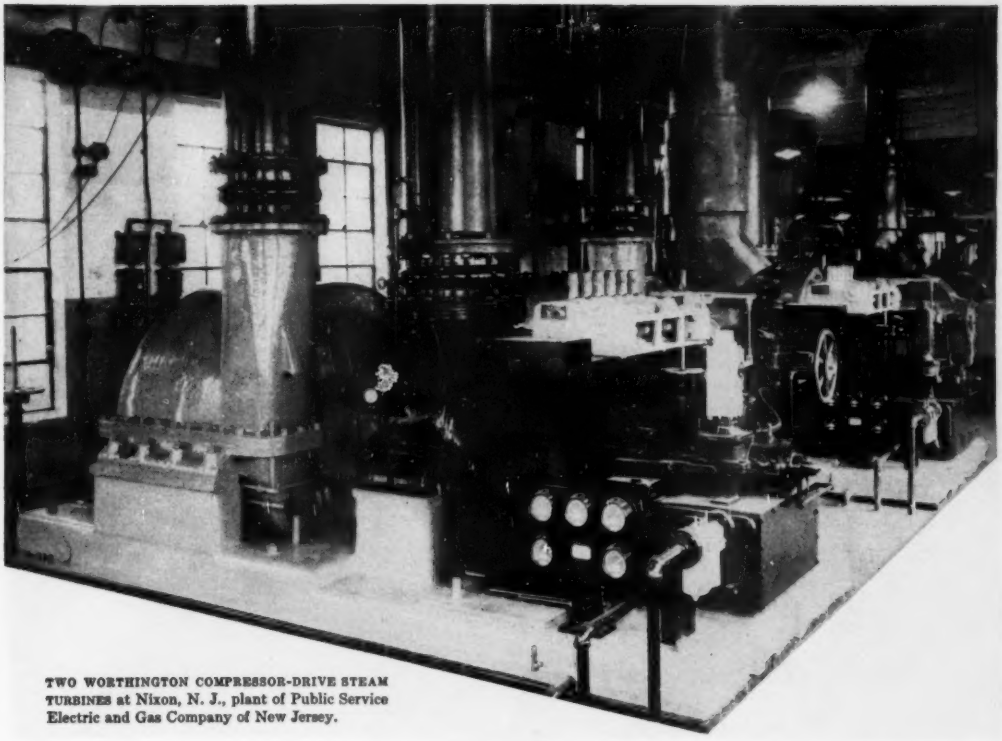
Canadian Sirocco Company, Ltd., Plant, Windsor, Ontario

New American Blower California Plant, San Leandro, California



TWO WORTHINGTON COMPRESSOR-DRIVE STEAM TURBINES at Nixon, N. J., plant of Public Service Electric and Gas Company of New Jersey.

Over 30 Worthington compressor-drive turbines serve Public Service of New Jersey

In a business where "service" is always the first consideration, Public Service of New Jersey has picked a long-service performer—the Worthington Steam Turbine—over thirty times, for installations from Jersey City to Trenton.

Public Service of N. J., like many other Worthington users, know that the biggest secret behind the Worthington turbines' service reliability lies in *engineering*—Worthington's ability to design a steam turbine to fit any mechanical drive. And that engineering ability is backed by experience in thousands of installations of all types and sizes—*the broadest experience you can find in compressor-drive engineering.*

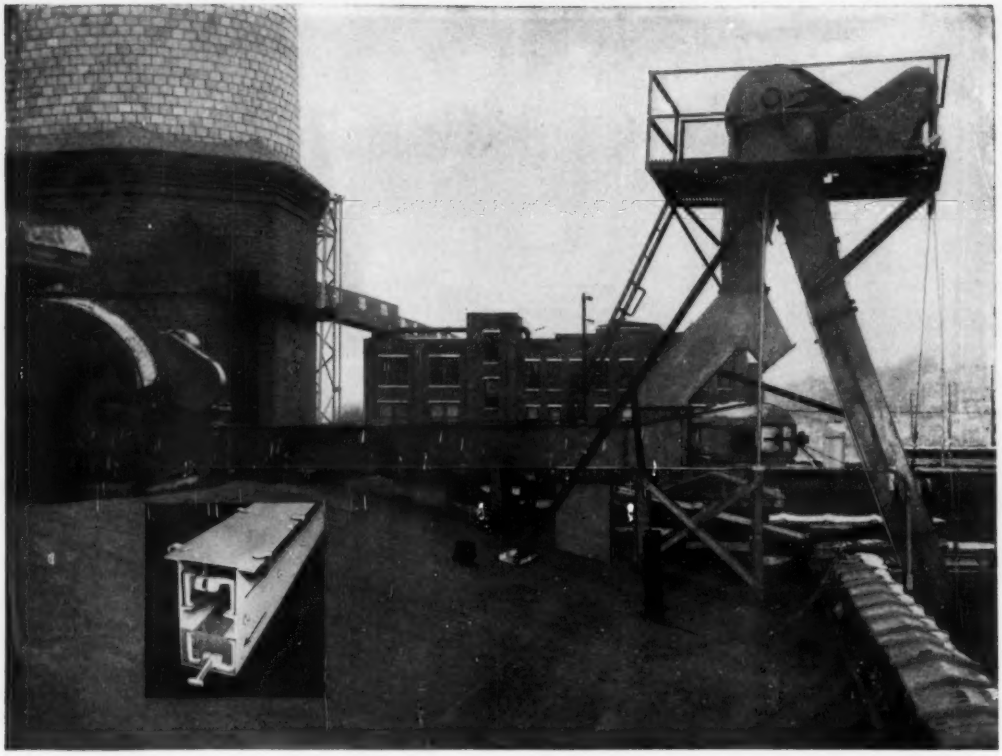
Worthington builds compressor-drive turbines—all types and sizes—up to 25,000 hp. A wide variety of governors fits them for all operating conditions. Write for bulletins to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

T.1.6

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines



Coal has to STEP FAST at this power plant

Twenty-five tons of coal per hour—from cars to bunker—is the proved performance of this S-A REDLER installation, requiring very little space and minimum supports. It is typical of the way S-A engineers, with more than half a century of specialized experience to draw upon, solve specific material handling problems. . . . If you have a question on moving bulk materials you will save time and money—and assume no obligation—by talking it over with qualified S-A engineers. Your inquiry is respectfully invited.

ENDICOTT-JOHNSON CORPORATION
Endicott, N. Y.

Roof top view shows head end of REDLER elevator transferring coal to a 20-foot long horizontal REDLER conveyor which discharges through four outlet chutes into boiler room bunker located directly below roof. Coal is received in a track hopper, is fed to an S-A KNITTEL ring-type crusher and then delivered to the feed section of the REDLER elevator. Coal placed on yard storage can be reclaimed to a special hopper for re-entry into the REDLER handling system.

1901-1951
50 years experience with bulk handling
STEPHEN S-A ADAMSON MFG. CO.
5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

HALL can help find the answers to *Your* water problems ...

here are a few examples:

METAL

2 miles of buried water mains, many service lines fed water-cooled elements of equipment in metal refining plant. Water left heavy scale on cooling elements, causing failure. Corrosion of main lines developed. Hall and the refinery stopped both scale and corrosion with Threshold treatment.

HALL

PAPER

Paper rejects were high due to poor sizing. Since water was blamed, Hall engineer made plant study, found that sizing procedure on one shift was not properly controlled. Situation was corrected and trouble stopped. Hall Engineer helped paper company find the trouble even though water wasn't responsible.

HALL

POWER

Routine check of 18,000 lb. per hr. boiler by Hall Service Engineer showed proper water conditions. Hard deposit found under normal sludge in mud drum was a "stopper." Hall report suggested heat leakage against drum. A check showed that packing between bridge wall and drum was gone. The Hall Engineer *predicted* the trouble in this case.

HALL

CHEMICAL

To speed up batch thermal processings of vegetable oils, plant engineers used extended-surface exchanger tubes. After repeated corrosion failures, Hall was consulted. Hall helped plant engineers effect design changes and set up chemical treatment. Processing units now stay in production.

HALL

WATER SUPPLY

Expanding plant needed more water. Before drilling new wells, Hall was consulted. Hall helped solve a stubborn slime problem, synchronized supply and demand, reduced water consumption 50%—then doubled well capacity with new well-cleaning method. Result: No new wells, plenty of water for planned expansion, money saved.

HALL

LET HALL ENGINEERS HELP SOLVE YOUR WATER PROBLEMS

▶ ***Write today for your copy of our bulletin on this subject.***

HALL PLANT WIDE WATER SERVICE • HALL PLANT WIDE WATER SERVICE • HALL PLANT WIDE WATER SERVICE

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HAGAN CORPORATION

Consultants on:

- **Procurement**
- **Treatment**
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- **Disposal of Industrial Water**

HALL LABORATORIES, INC. P-2

HAGAN BUILDING, PITTSBURGH 30, PA.

Please send me your bulletin: Let's Consider Your *Whole* Water Problem.

Name_____

Position_____

Company_____

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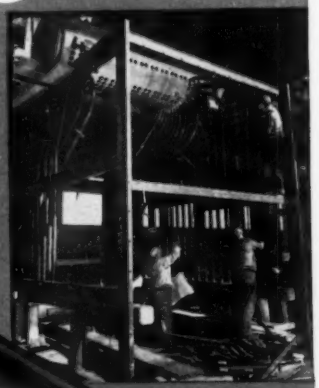
City_____ Zone____ State_____

HALL PLANT WIDE WATER SERVICE

HALL PLANT WIDE WATER SERVICE • HALL PLANT WIDE WATER SERVICE • HALL PLANT WIDE WATER SERVICE

They fit right . . .

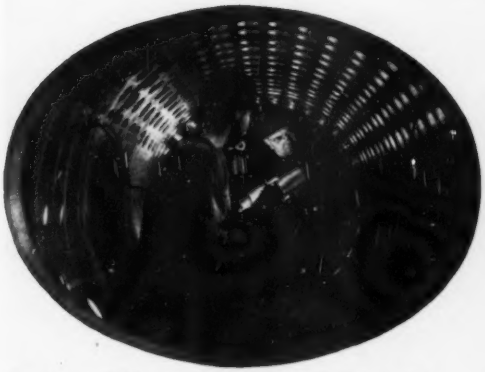


ELECTRUNITE Tubing is free from rolled-in scale and scale pits INSIDE AND OUT

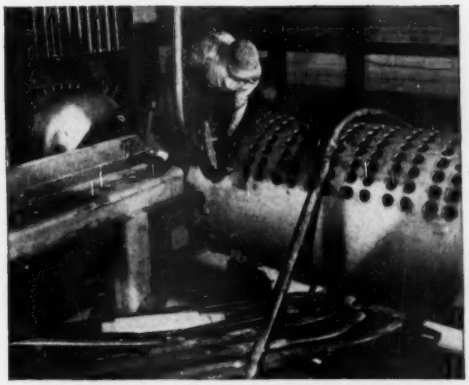
THE ORIGINAL

Electric Welded Pressure Tube

Roll-in tight . . .

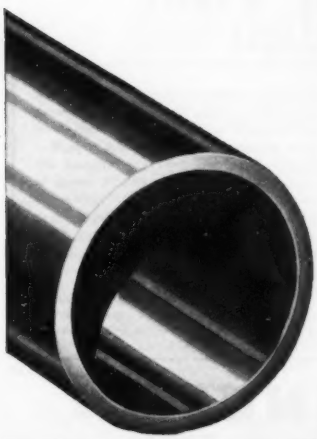


ELECTRUNITE Tubes are full-normalized their entire length. Cut anywhere, they roller-expand and bead-over to tight, non-leaking joints without annealing.



Uniform ductility of ELECTRUNITE Tubing permits prefabrication with assurance of exact fit in any installation.

ELECTRUNITE BOILER TUBES



SMOOTH, ACCURATE O.D.'s make ELECTRUNITE Boiler Tubes fit drum holes neatly, go in easily. Full-concentric contours eliminate binding and hanging of tubes in holes.

Uniform ductility, plus full-normalized structure, make ELECTRUNITE Boiler Tubes roll-in smooth and tight. You get tight bead-overs with maximum freedom from weepers and leaks.

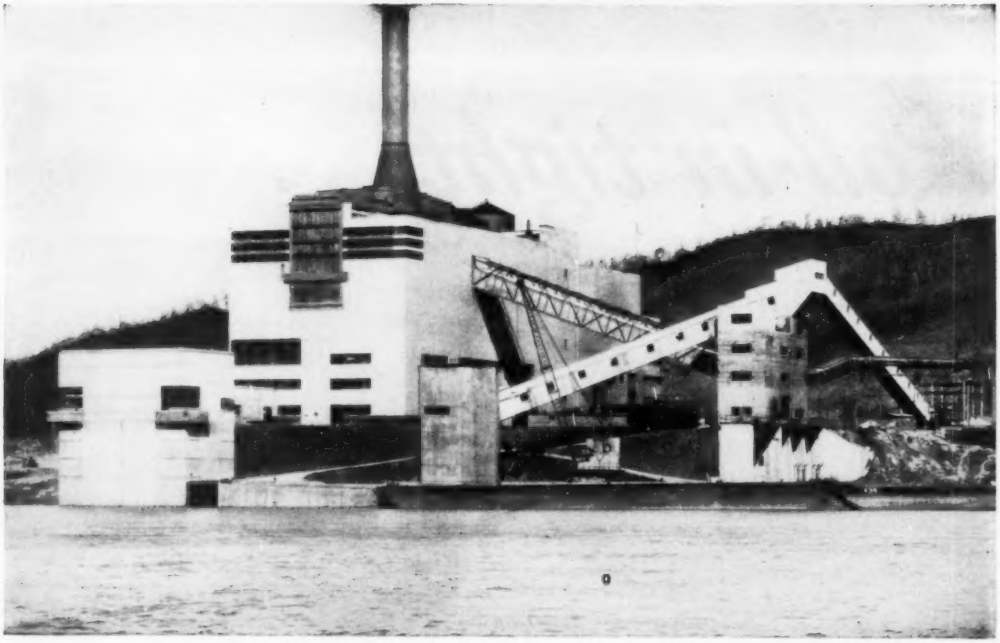
Users of ELECTRUNITE Boiler Tubes report as much as 30% reduction in time required to tube a boiler . . . or retube it. ELECTRUNITE inside-and-out inspection is your assurance that tubes are free from scabs and rolled-in scale, that tube walls are uniform in thickness and quality.

Write for information and design data on Republic ELECTRUNITE Boiler Tubes . . . the *original* electric-resistance-welded pressure tubes for boilers and heat exchangers.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 EAST 131st STREET • CLEVELAND 8, OHIO

REPUBLIC STEEL

Republic
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

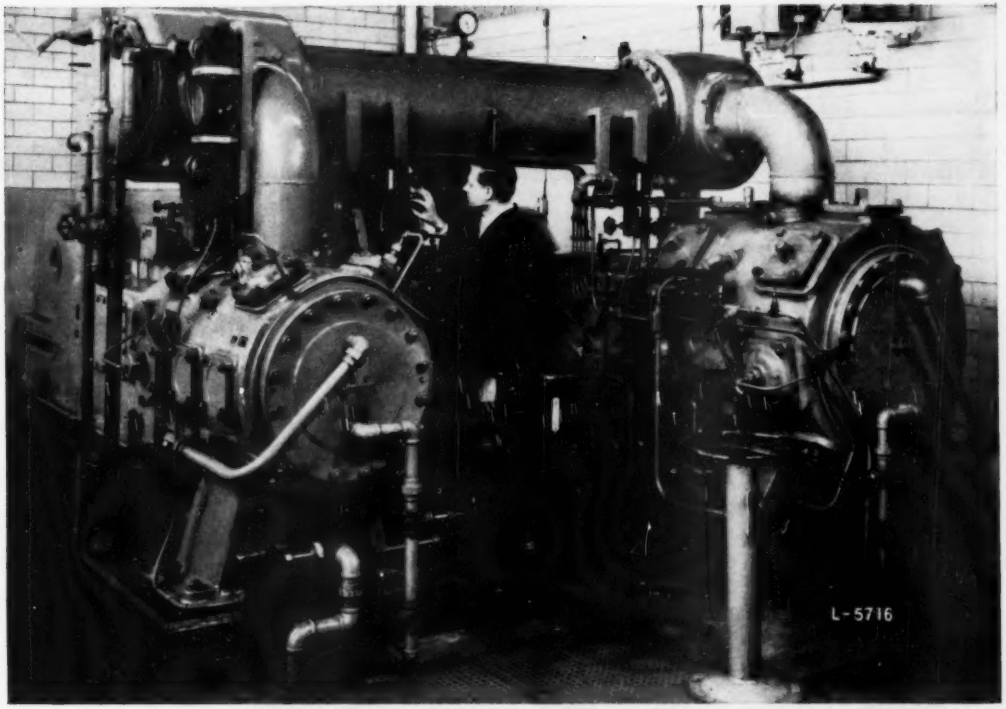
*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers



WORTHINGTON DC2 HORIZONTAL AIR COMPRESSOR at Jeffrey Manufacturing Co., Columbus, Ohio

Worthington air helps build Jeffrey mining and material handling equipment

This Jeffrey installation at Columbus, Ohio, typifies the best and most efficient in Compressed Air Equipment.

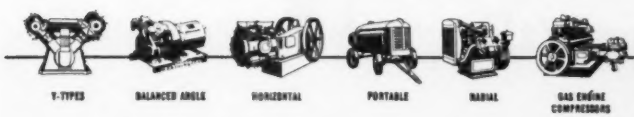
Equipped with Worthington's Five Step By-pass Capacity Control, the compressor requires *less* horsepower and *less* maintenance because of:

1. Reduced operating temperature at part loads.
2. Reduced part-load power consumption.
3. Reduced cylinder and ring wear because of improved lubrication.
4. Reduced carbon deposits on valves.

Jeffrey also operates a Worthington 350-hp steam driven compressor, a 10-hp single horizontal for soot-blowing, and a 10-hp vertical compressor for instrument air.

For dependable, efficient compressed air requirements, always specify Worthington. Write for Bulletin L-675-B1B to Worthington Pump and Machinery Corporation, Compressor Division, Buffalo 5, New York.

K.1.16



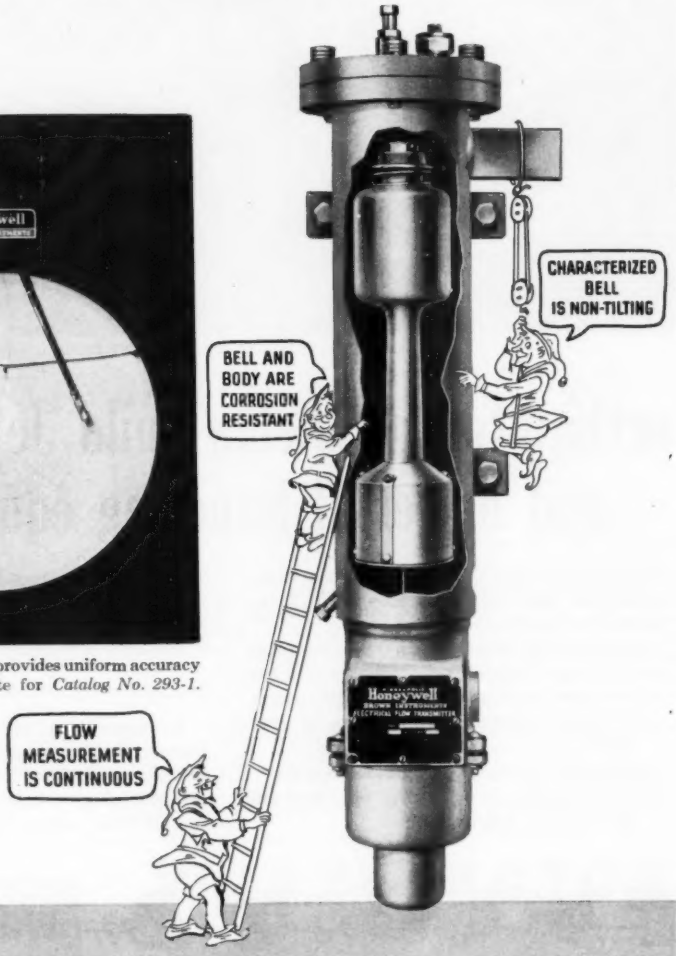
No Other Compressor Will Outperform a Worthington

WORTHINGTON
Compressors

Important Contribution to

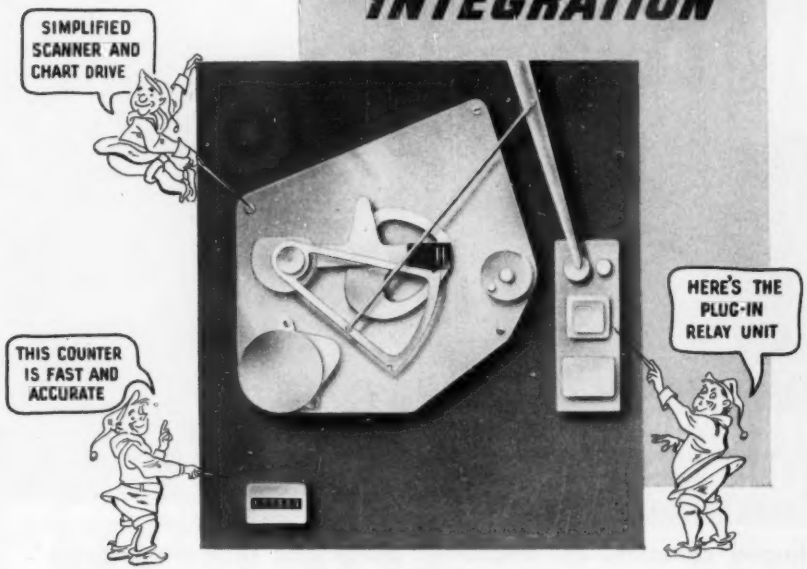
The Brown Electric Flow Meter

EVENLY DIVIDED CHART... provides uniform accuracy for all rates of flow. Write for *Catalog No. 293-1.*



Flow Measurement and Accounting

incorporates . . . ELECTRONIC INTEGRATION



Two important features...evenly divided chart and electronic integration... facilitate flow cost accounting; eliminate intermittent measurement and slow, complicated totalizing.

The electronic integrator, consisting of but three major parts, simplifies accessibility and maintenance . . . permits quick checking and calibration. Scanning is rapid and extremely simple. The corrosion resistant meter body is of tubular construction, reducing weight and bulk. Transmission is electric. Mechanical flow meters, evenly graduated and similar to that shown, but with the bell directly coupled to the recorder pen are also available. Recorder is fast, chart is easily read under all conditions of flow. The characterized bell is corrosion resistant, too, and is specially designed to eliminate tilting.

Call in our local engineering representative for a discussion of your application.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

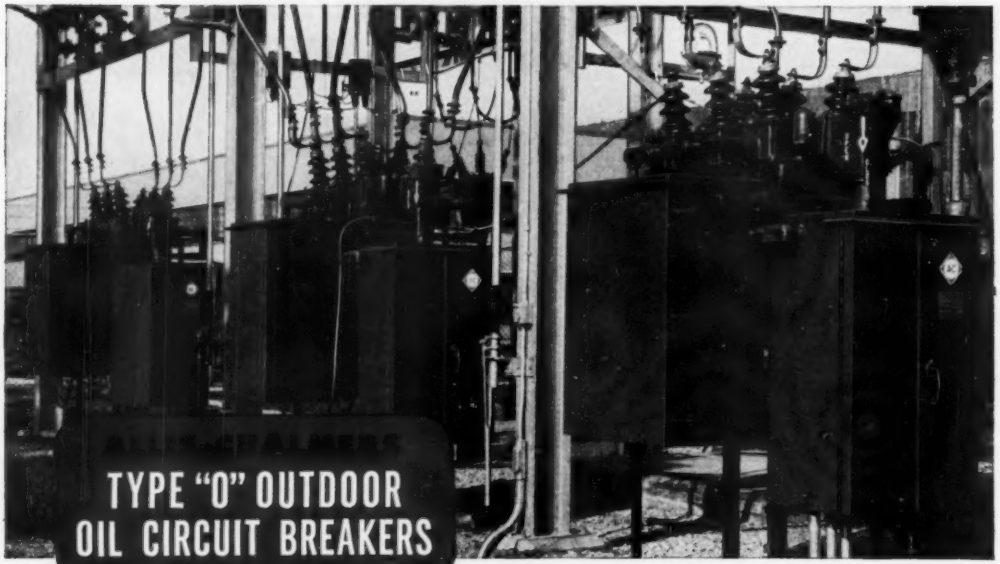
● *Important Reference Data*

Write for a copy of Catalog No. 293-1, "Evenly Graduated Flow Meters" . . . and Bulletin No. 90-2, "Supervisory Instruments for Power Generation."

Dependable

ELECTRICAL PROTECTION

FOR DISTRIBUTION SYSTEMS



Packaged complete for improved automatic reclosing service

ALL YOU NEED to order your type "O" breaker is one set of specifications. It's simple and convenient. This standard 3-pole breaker comes to you mounted on a strong lightweight framework with operating mechanism and automatic reclosing equipment each in its own weatherproof housing. The type "O" breaker is factory assembled, wired and tested in accordance with ASA standards . . . ready to install and operate.

SECURE THESE PROVEN ADVANTAGES

1. **Positive, high speed breaker action with mechanically and electrically trip-free solenoid operating mechanism, ac or dc operation as specified.**
2. **Efficient circuit interruption with high rate of dielectric recovery for low contact and oil deterioration.**
3. **Automatic reclosing duty for unattended stations with standard protective and reclosing relay equipment included.**

Feature for feature you cannot buy better breakers in this class. Over 50 years of Allis-Chalmers progress in power circuit breakers is built into them. You can install them with complete confidence. For more information call your local A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for bulletins 71B6165A (OX-18) or 71B6093C (OZ-110, OZ-210).

A-3440

Type	Rated KV	Rated Amps. (60 cycle)	Interrupting Capacity KVA
OX-18	7.2	600	50,000
OZ-110	14.4	600	100,000
OZ-210	14.4	600	250,000
OZ-210	14.4	1200	250,000
OZ-210	23	600	250,000

ALLIS-CHALMERS

We saved 33.9% on fuel alone with this Iron Fireman method of coal firing

Mr. H. A. Quinn
Manager Toledo Laundry

Here's the Record

Fuel costs down 33.9%

Steam processing temperature up 5%

Average CO_2, 12.9%

Boiler pressure, 125 PSI

Average stack temperature, 452° F.

Iron Fireman

PNEUMATIC SPREADER STOKERS

A COMPLETE COAL DRYING, CONVEYING, DISTRIBUTION AND COMBUSTION SYSTEM. Coal is thoroughly dried and pre-heated and is conveyed pneumatically to furnace grates. Dry coal assures far more uniform distribution over *entire* grate in shallow, uniform fuel bed. Pre-heated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness as compared with stokers which do not pre-heat coal.

Fuel savings, plus labor savings resulting from automatic conveying, plus the stoker's ability to follow a fluctuating load—these are the reasons given by Mr. Quinn for installing the Iron Fireman Pneumatic Spreader at the Toledo Laundry after several years' experience with similar Iron Fireman equipment in the company's two other plants.

No other stoker combines the many exclusive features and money-saving extras of the Iron Fireman Pneumatic Spreader stoker. Manual coal handling is completely eliminated—and without extra cost, because the automatic coal conveying system is part of the stoker itself. So flexible is this conveying system that coal bunkers can be located almost anyplace with reference to the boilers—back, front or sides. In one installation that has been operating for years coal is fed from bunkers 32 feet below the firing floor.

Fully modulated fuel feed and air volume are automatically synchronized. Air supply is kept in step with coal feed-rate at all times. Coal is thoroughly pre-dried for uniform distribution. Capacities range to 1,000 boiler horsepower for a single unit. Multiple units for larger boilers. Send for descriptive literature.

Coal, Gas, Oil firing equipment for heating, processing, power

WRITE FOR CATALOG

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3246 West 106th Street, Cleveland 11, Ohio.

Send me literature on the Iron Fireman Pneumatic Spreader Stoker.

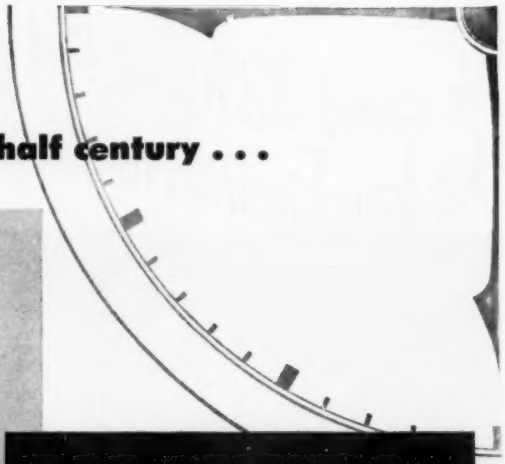
Name_____

Address_____

City_____ State_____

Now a new name

to start our second half century . . .



CHICAGO METAL HOSE CORPORATION

Flexonics *Corporation*

Sales operations are divided into four logical divisions

CHICAGO METAL HOSE DIVISION

Corrugated and convoluted flexible metal hose, machine tool conduit, refrigeration conduit, "Vibra-Sorber" vibration eliminators for piping, and assemblies for specific applications.

AIRCRAFT DIVISION

Stainless steel aircraft components including hose of all types, bellows, oil and fuel lines, air lines, ducting and connectors of all types and many special assemblies for jet aircraft.

FLEXON BELLOWS DIVISION

Stainless steel bellows, brass and bronze bellows, automobile thermostats and bellows and bellows assemblies and devices for all types of standard and specialized applications.

EXPANSION JOINT DIVISION

Standard corrugated packless type expansion joints in free-flexing and controlled-flexing construction, high pressure Flexoniflex expansion joints, heat riser expansion joints, and special joints.

• In 1947, Chicago Metal Hose Corporation introduced to industry a new science—the science of Flexonics. It is defined as the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion. This definition so well describes our operations and the expanding range of our products that we are adopting it as our corporate name coincident with our 50th anniversary year.

Let us assure you, however, that the change from Chicago Metal Hose Corporation to Flexonics Corporation involves no change in management, personnel or methods of operation except for internal organizational changes that will make it possible for a fast growing company to serve its customers better.

Flexonics *Corporation* **1301 S. THIRD AVENUE · MAYWOOD, ILLINOIS**

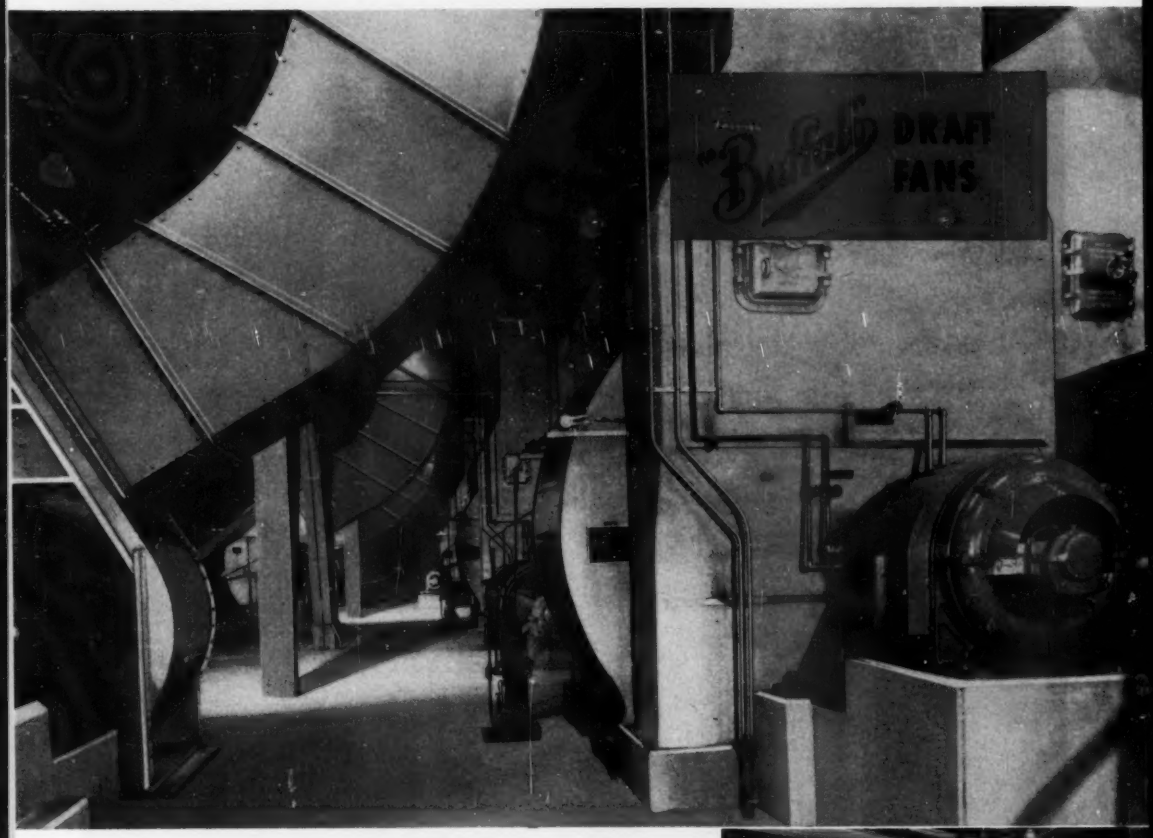
FORMERLY CHICAGO METAL HOSE CORPORATION

Flexon identifies CMH products that have served industry for over 50 years.

Manufacturers of Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems • Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

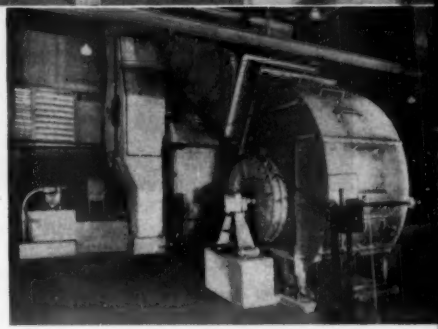
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

AIR POWER TO MEET LOAD DEMANDS *Quickly and Continuously*



For the important and punishing draft job, you want fans that will meet your varying load demands dependably. You also want fans that are built for the long run—fans that aren't continually requiring attention and repairs. And that means "Buffalo" Fans. These are the draft fans that have set endurance records in every type of power plant—many 25-year-old "Buffalo" Draft Fans still on the job have earned their keep many times over. That's because every part of these fans is built oversize—built specifically to stand draft service.

Above is a recent "Buffalo" installation in a municipal public utilities station. Three "Buffalo" Induced Draft Fans are on the right of the aisle, while three Forced Draft Fans are at left. *Consulting Engineers for this project were GILBERT ASSOCIATES of Reading, Pa.*



More fans in the same station. In the foreground is a "Buffalo" F.D. Fan with variable inlet vanes for regulating combustion. In the rear is an insulated "Buffalo" I. D. Fan.

For helpful information on dependable draft service, write today for BULLETIN 3730.

FIRST FOR FANS

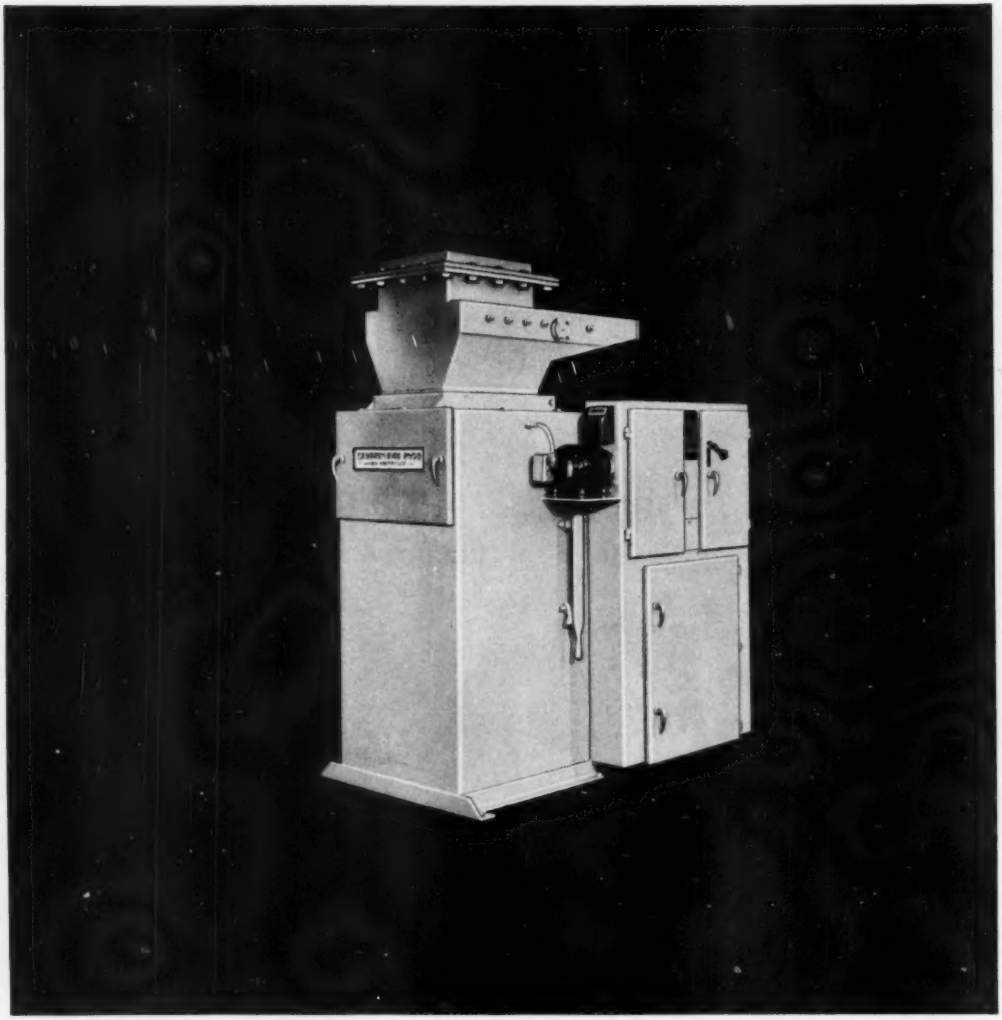
BUFFALO "FORGE" COMPANY

488 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

S-E-Co. Coal Scales Handle Wet Coal



S-E-Co. Coal Scales are designed to handle wet coal. The width of the coal stream on the scale feed belt is exceptionally wide and the skirt bars are vertical—thus reducing the possibility of arching at coal scale inlet.

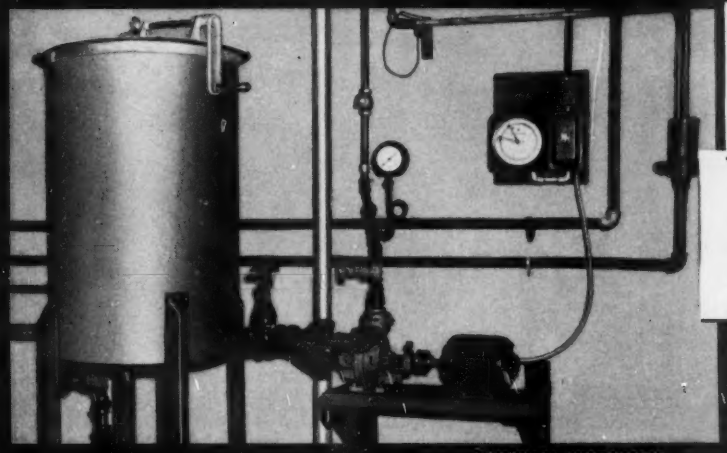
S-E-Co. Coal Scales are also equipped with a rubber belt feeder to which there is little tendency for the coal to adhere and, as a result, wet sticky coal is handled by these units without feeder difficuty.

Feed belts of **S-E-Co.** Scales have beaded edges and they slope downhill. All water, drained from bunker, passes through the stainless steel weigh hopper—hence no corrosion of scale body or weigh hopper.

If you are troubled by wet coal problems, use **S-E-Co.** Coal Scales.

SEND YOUR INQUIRY TO **STOCK EQUIPMENT COMPANY**

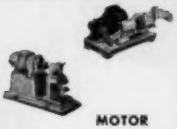
715 P HANNA BUILDING • CLEVELAND 15, OHIO



AUTOMATIC INTERMITTENT FEEDING

BY-PASS FEEDERS

MECHANICAL CHEMICAL PUMPS



MOTOR OPERATED CHEMICAL PUMPS

AUTOMATIC CYCLE CONTROL

WATER TESTING CABINETS

FLO-CONTROL VALVES —TIMERS

Dearborn has the ENGINEERED EQUIPMENT for your water treatment

To get the most from your water treatment, it's essential that the entire system be engineered for maximum efficiency.

Here Dearborn will help by analyzing your existing equipment and physical layout. With this information, a Dearborn engineer will then recommend the necessary equipment, whether it is to include a pump or timer—a test cabinet—or an automatically controlled feeding system.

Why not plan to discuss your water treatment and other boiler room problems with your Dearborn engineer? He will bring you all the benefits of Dearborn's broad experience in this field since 1887.

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WRITE FOR INFORMATION ON THE EQUIPMENT YOU NEED

Use the coupon!

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza, Chicago 54, Ill.

- ☐ De-ionizing units
- ☐ Chemical pumps, motor
- ☐ Chemical pumps, mechanical
- ☐ Continuous blow down systems
- ☐ Timers
- ☐ Test cabinets
- ☐ Cooling water samplers
- ☐ By-pass feeders
- ☐ Automatic intermittent feeding
- ☐ Cycle controlled feeding

Please send information on the items checked above.

☐ Have a Dearborn Engineer call.

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Company.....

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City.....*Zone*....*State*.....

Dearborn

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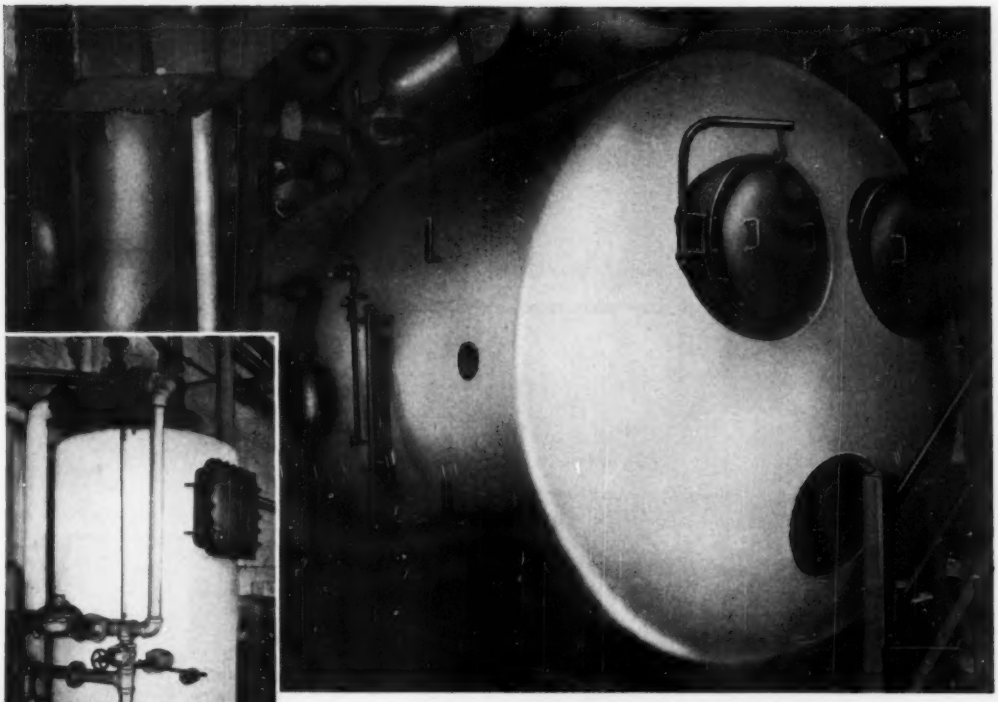
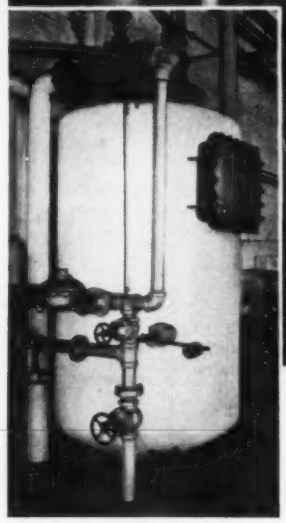
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES





A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

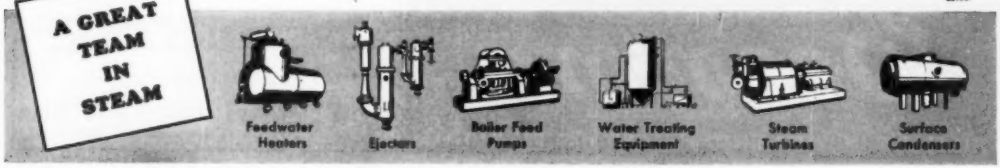
Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S-1-5

A GREAT TEAM IN STEAM



PHILIP SWAIN, EDITOR · FEBRUARY 1952 · ESTABLISHED 1882 **Power**
COMBINED WITH OPERATING ENGINEER

Plain Talk on Atomic Power

THE NIGHT OF DECEMBER 21-22, 1951, saw the world's first electric-power generation from splitting atoms. In a test run, 100 kilowatts of atomic power operated all the facilities at the National Reactor Testing Station, Arco, Idaho.

This historic event was a colorful incident in experiments that will test the feasibility of "breeding" fissionable material. Breeding means so operating a reactor as to generate at least one ounce of plutonium for each ounce of U235 or plutonium consumed. Since plutonium is just as good an atomic fuel as U235, this breeding demonstration will prove we can "burn" the entire mass of natural uranium instead of the mere one part in 140 that is the naturally fissionable U235.

When breeding is demonstrated, we can truthfully say that one pound of natural uranium equals 1500 tons of coal in heat output. And even if this natural uranium should cost as much as $45 per pound, its heat would match that of coal at three cents a ton.

This rosy arithmetic, plus the recent proof that atomic power is mechanically workable, may suggest that big-scale commercial atomic power is right around the corner. Not so! "All is not gold that glitters."

We must remember that man for centuries has known how to make power with zero fuel cost—by falling water, wind, tides, waves and sunshine. Of these, only hydro is important today. All these match atomic power in two vital respects: (1) The plants cost a lot to build. (2) They save a lot of coal, and little else.

Beyond the point of steam generation the atomic plant need not differ from a conventional coal-fired power plant. The great difference, and the great excess of cost, lies in the atomic reactor, in the elaborate equipment required to convey heat from reactor to steam generator, and in the complex plants for chemical processing and disposal of waste fission products.

So the economic problem is one of balancing the *additional* first cost of the atomic-power plant against a coal saving of, say, 4 mills per kwhr. Designing an atomic plant that will pay its keep on this businesslike basis is a tough assignment for our best engineering minds. Early success can hardly be imagined.

Years before that future birthday of truly self-supporting atomic-power plants, we shall see such plants that are mechanically reliable, and subsidized either by development dollars or as byproduct operations in atom-bomb manufacture.

The earliest examples of truly self-supporting atomic-power plants may be very large stations, supplying electrochemical plants at high load factor and located near markets or raw materials in places where coal is costly —very likely in remote countries.

Although the future course of atomic-power plant-construction costs remains a vast unknown, we can draw certain practical conclusions now, based on practically free atomic fuel. We merely ask how much additional can we afford to invest to save the present coal bill?

Working this out for 4-mill coal cost, and a 15% fixed-charge rate, we find that the additional cost of the atom plant should be no more than $230 per kw for 100% load factor, and no more than $115 for 50% load factor. We expect that it will take years to achieve even the $230 differential, which is why we predict a slow development of atomic power, but with the exceptions noted.

This editorial started on the rosy theme of ultra-cheap atomic fuel, then switched to a rather cold-blooded preview of atomic power. To avoid any suggestion that your editors are horse-and-buggy engineers, let us conclude by restating our conviction that the atomic-energy program, as a whole, is of immense importance. America must continue atomic developments under full steam, spending billions to probe the atom for new secrets, and applying this new knowledge to medicine, agriculture and industry. Also, we have the atom bomb by the tail and don't dare let go. So the bombs may subsidize the power.

UNITED STATES CAPITOL

WASHINGTON, D. C.

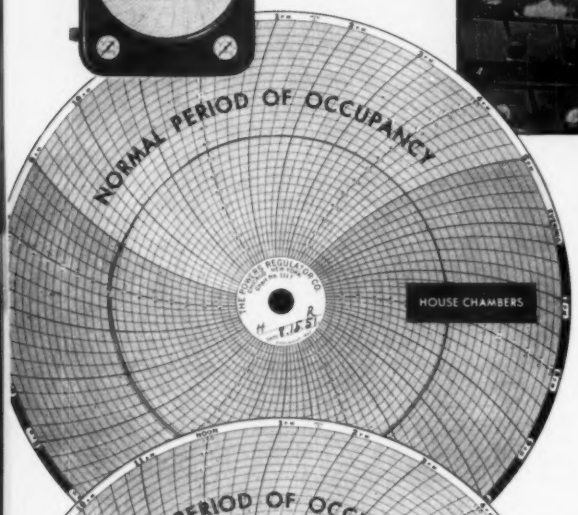
Uses POWERS System of AIR CONDITIONING CONTROL

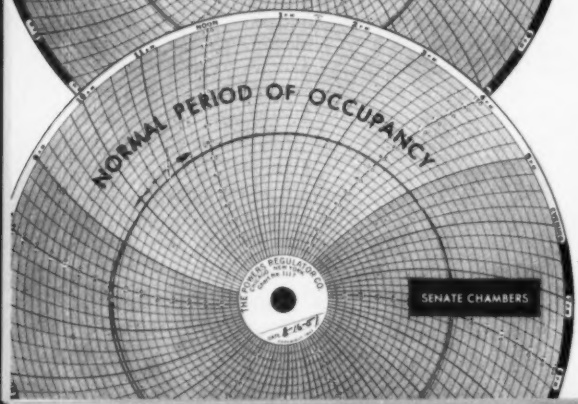
Right: Joint session of the Congress in the recently remodeled House of Representatives—listening to "State of the Union" address by the President.

In the historic House and Senate Chambers as well as the administrative offices in the Capitol, heating and air conditioning systems are regulated by a Powers system of pneumatic control.

Only a few of the many types of Powers Control used in the Capitol are shown here.

Left: Powers Two-pen Recording Controller.





World's Largest and Most Comfortable Legislative Hall is Regulated by—

POWERS AIR CONDITIONING CONTROL

◀ **Note Accurate Control in House and Senate Chambers**

Outdoor temperatures, during the period covered by the temperature charts varied between 75 and 95° F., yet indoor temperature was maintained constant from 9 A. M. to 5 P. M. One temperature sensitive bulb is located near the speaker's rostrum, another is in the gallery. Note separate lines during the off period of control and how the two lines merge into one when Chambers were occupied.

THE POWERS REGULATOR CO.

3400 OAKTON ST., SKOKIE, ILLINOIS • Offices in Over 50 Cities

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Over 60 Years of Automatic Temperature and Humidity Control

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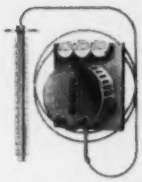
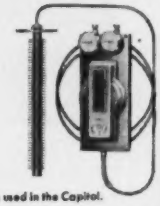
Department of Agriculture and Post Office Department Bldgs., Department of Interior and Old House of Representatives Office Bldgs., Social Security R. R. Retirement Bldg., Apex Bldg., Lafayette Bldg., U. S. Navy Hydrographic Bldg., Washington National Airport.

Experience gained by Powers in supplying dependable temperature and humidity regulation for these buildings may be helpful to you. When your problems involve precise control for heating or air conditioning, contact Powers nearest office . . . in over 50 cities.

Powers Room Type Thermostat

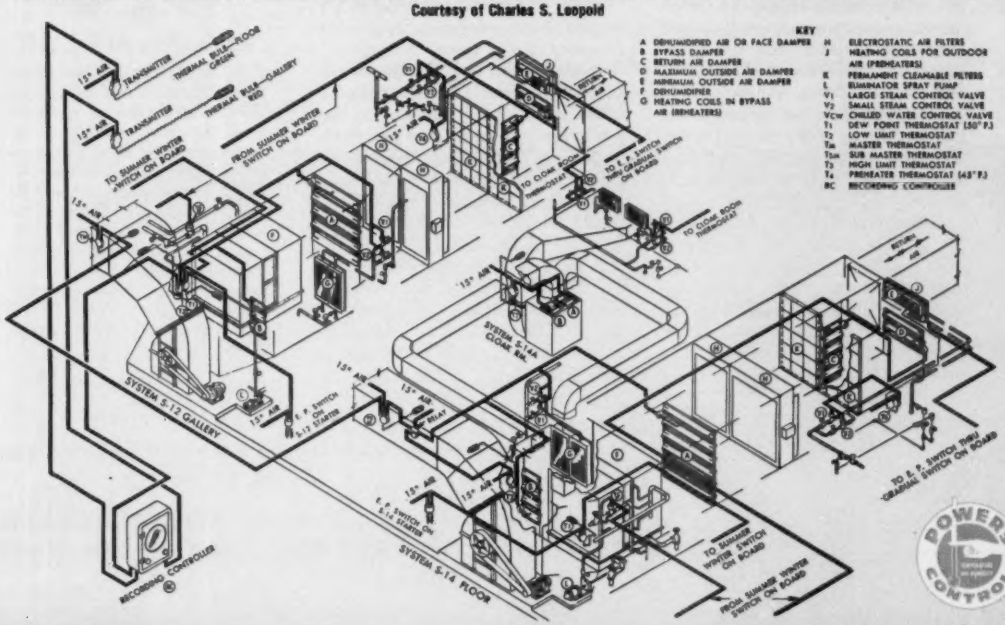




Powers Remote Bulb Thermostats for Dew Point, Low and High Limit, Preheater, Master and Sub-Master Control —only a few of the many controls used in the Capitol.

AIR CONDITIONING APPARATUS DIAGRAM FOR OPERATION AND MAINTENANCE OF SYSTEMS IN THE HOUSE AND SENATE CHAMBERS

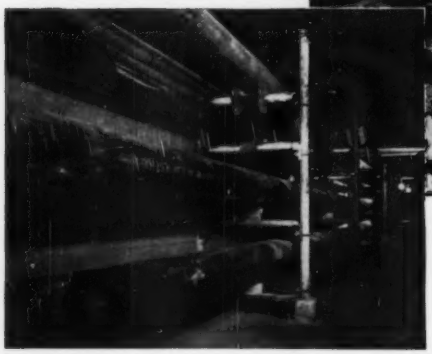
Courtesy of Charles S. Leopold


KEY
A DEHUMIDIFIED AIR OR FACE DAMPER
B BYPASS DAMPER
C RETURN AIR DAMPER
D MAXIMUM OUTSIDE AIR DAMPER
E MINIMUM OUTSIDE AIR DAMPER
F DEHUMIDIFIER
G HEATING COILS IN BYPASS AIR (REHEATERS)
H ELECTROSTATIC AIR FILTERS
J HEATING COILS FOR OUTDOOR AIR (PREHEATERS)
K PERMANENT CLEANABLE FILTERS
L ELIMINATOR SPRAY PUMP
V1 LARGE STEAM CONTROL VALVE
V2 SMALL STEAM CONTROL VALVE
VCW CHILLED WATER CONTROL VALVE
T1 DEW POINT THERMOSTAT (50° F.)
T2 LOW LIMIT THERMOSTAT
TM MASTER THERMOSTAT
TSM SUB MASTER THERMOSTAT
T3 HIGH LIMIT THERMOSTAT
T4 PREHEATER THERMOSTAT (45° F.)
RC RECORDING CONTROLLER
TRANSMITTER
THERMAL BULB—FLOOR GREEN
THERMAL BULB—GALLERY RED
TO SUMMER WINTER SWITCH ON BOARD
FROM SUMMER WINTER SWITCH ON BOARD
TO CLOAK ROOM THERMOSTAT
SYSTEM S-12 GALLERY
SYSTEM S-14A CLOAK RM.
SYSTEM S-14 FLOOR
RECORDING CONTROLLER
TO SUMMER WINTER SWITCH ON BOARD
FROM SUMMER WINTER SWITCH ON BOARD

POWERS CONTROL

(a73)

In the air conditioning chilled water distribution system



THIS UNIVERSITY COMBATTED THE CORROSION PROBLEM WITH

Byers Wrought Iron Pipe

When plans were made for the air conditioning chilled water distribution system at a well-known university in the Southwest, the specifiers followed sound, proven practice in safeguarding the installation against premature failure and excessive maintenance by specifying genuine wrought iron. Over 116 tons of Byers Wrought Iron pipe was used in the chilled water header piping of the central water chilling station, chilled and condenser water lines, and steam condensate lines.

A network of chilled water lines, housed in a tunnel, carry the water from the power plant to the buildings. A portion of the tunnel installation is shown above. The two lower lines in the picture carry chilled and condenser water; the smaller, uncovered line above them carries steam condensate. Zumwalt and Vinther, Dallas, were the engineers on the job. R. O. Davis, Inc., Austin, were the contractors.

Byers Wrought Iron pipe has a record of long, dependable service in every one of these "hot spots." Its wide-spread and continued use in these services is the best possible index of its ability to stay on the job longer, at lower cost per year.

You will find some helpful information on the use of wrought iron in our bulletin, WROUGHT IRON IN REFRIGERATION AND AIR-CONDITIONING SYSTEMS.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

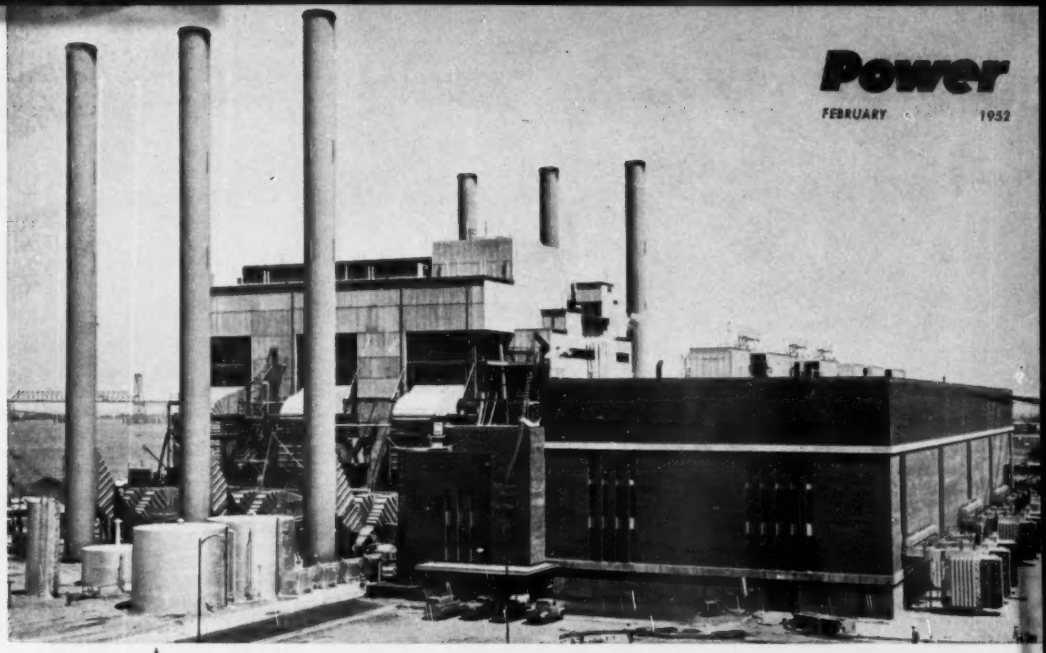
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
FEBRUARY 1932

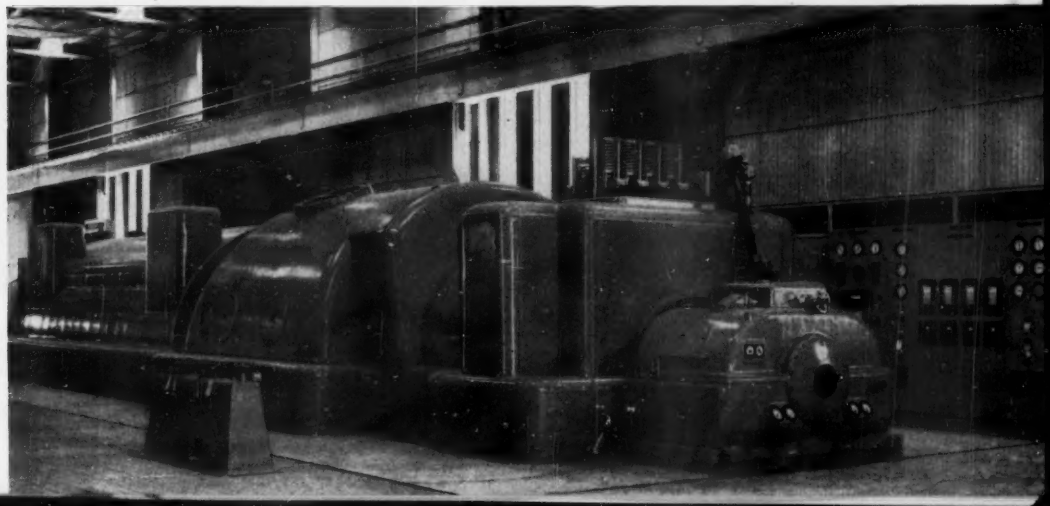


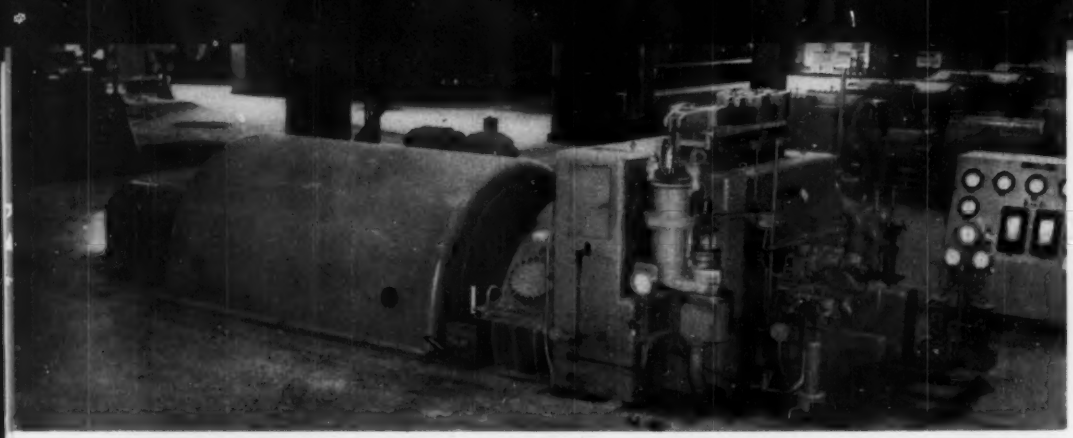
SEMI-OUTDOOR BOILERS SAVE building materials but are protected by umbrella-type enclosure of corrugated Transite. Firing aisle between six boilers completely enclosed. Building holds main and house turbine-generators, auxiliary equipment and control room. San Joaquin River, *left*, supplies cooling water. Fuel will be oil and gas

POWER Takes You Through New Contra Costa Plant

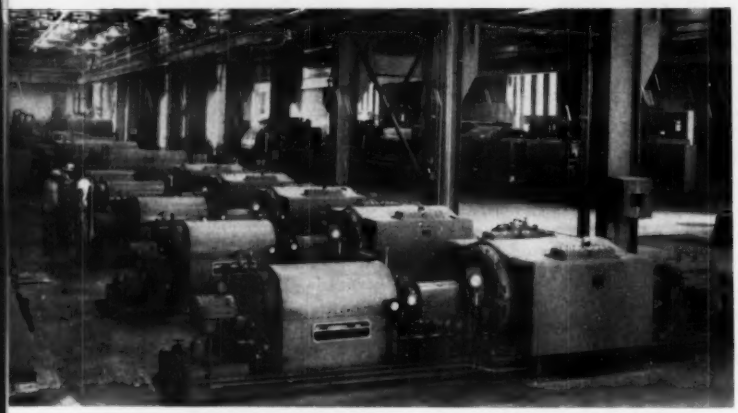
Pacific Gas and Electric Co places this record-size steam plant in service to supplement its hydro-station supply. Located near Antioch, Calif. gives best station utilization for system

NO. 2 MAIN TURBINE UNIT along with two other 100,000-kw turbine generators make up initial installation. Plant is being expanded to five units for total of 500,000 kw. 24-stage tandem-compound double-flow unit uses 1300-psig 950-F steam, exhausts at 1.5 to 3.0 in. Hg. Only four of five bleed points in turbine used for feed heating



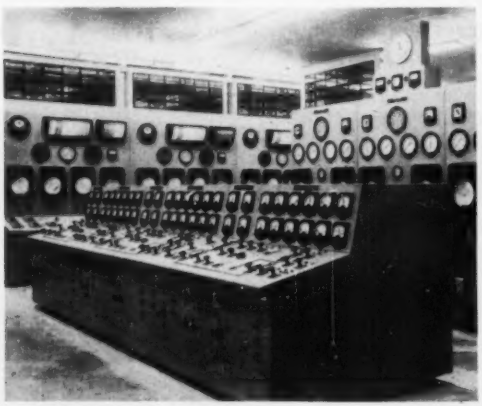


HOUSE TURBINE UNIT is heart of quick load-pickup feature. 7500-kw single-automatic-extraction condensing turbine drives generator supplying energy to station auxiliaries, all electrically driven. Unit runs in parallel with house transformer that normally feeds auxiliary demand. In case of transmission line trouble, house transformer trips out, turbine takes over auxiliary load. Bleed steam at 5 psig supplies heat to feed deaerator

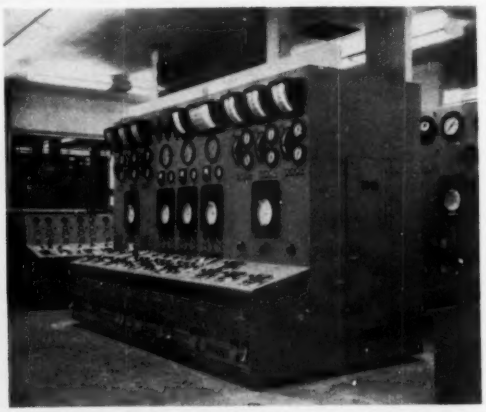


COMPOUND FEEDWATER PUMPS stand on main turbine floor for easy supervision. 8 pumps handle 550,000 lb per hr each against total head increase of 2000 psi. Two pumps carry full load on one main unit, two spares raise reliability. All piping under floor makes neat layout

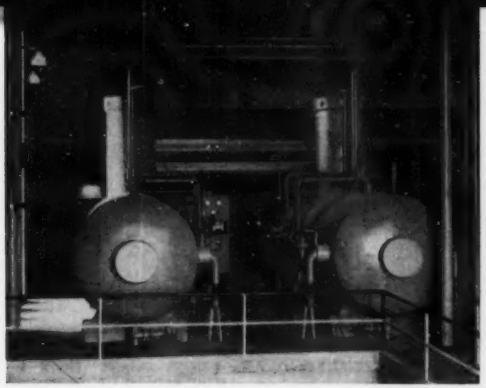
CONTRA COSTA MUST BE READY TO PICK UP FULL LOAD IN A FEW SECONDS WHEN RUNNING AT LOW LOAD ON STANDBY DUTY



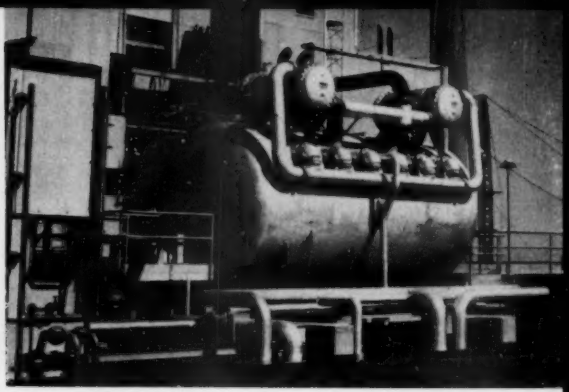
CONTROL-ROOM PANELS total up to 15 boards grouped in room 175x50 ft. Here are house generator, transformer boards, *front*, boiler, house-turbine boards, *rear*. Annunciator panels warn of trouble spots



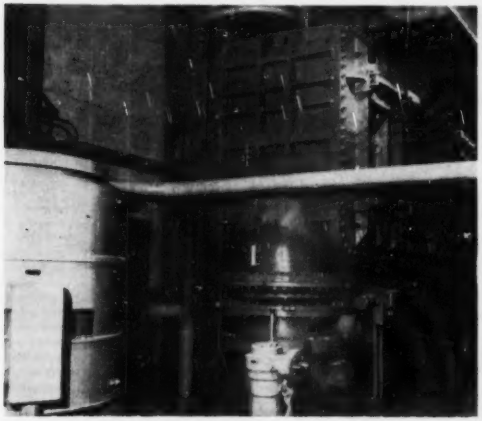
MASTER CONTROL BOARD in plant control room centralizes key controls for boilers, turbines, combustion and feed systems, major steam and feed motor-operated valves and auxiliary power sources



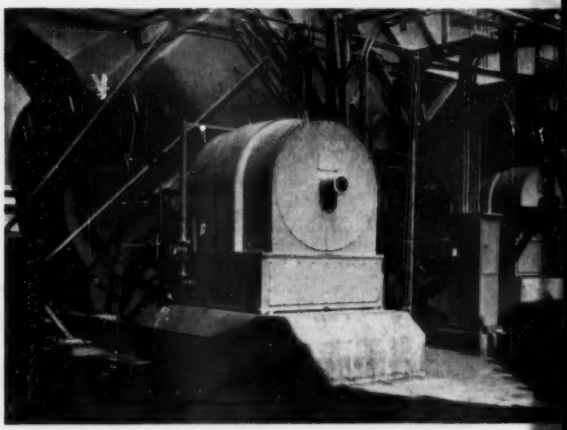
MAKEUP EVAPORATORS handle raw water taken from large reservoir under condensers through softening system. Evaporators take bleed steam from Units No. 1 or 3. Raw water comes from river



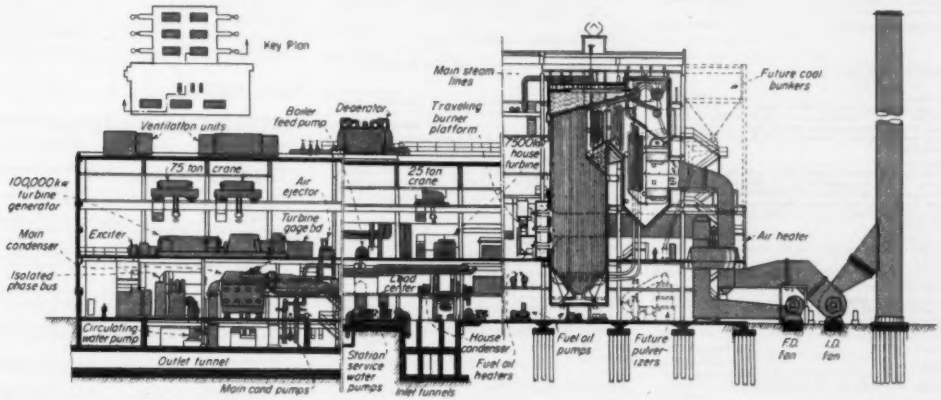
DEAERATING HEATER on roof of auxiliary bay gives positive suction head of 45 ft on feed pumps. Direct-contact type deaerator has two vent condensers, takes 5-psig steam from house-turbine extraction point



MAIN STEAM CONDENSERS have 50,000-sq-ft surface made up of 28-ft aluminum-brass tubes. Condenser neck welded solidly to turbine outlet. Vertical circulating and hotwell pumps serve units

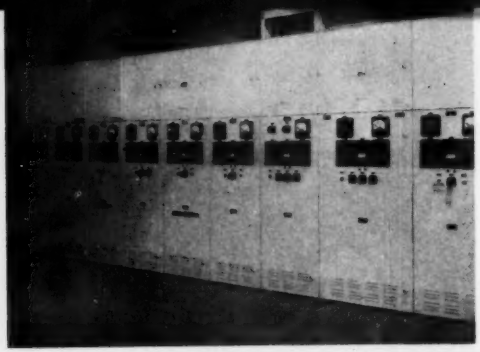


INDUCED- AND FORCED-DRAFT FANS for each boiler stand near each other outdoors. Fans run at full speed during low-load stand-by operation for emergency. Vanes and dampers control



STATION PLAN LAYOUT, shown in small sketch, above *left*, tells how elevation sections are taken through plant. Station has two main operating levels with control room centered so operators can see down central boiler aisle on one side, and the main and house units and boiler feed pumps on other side. Plant layout allows space for future conversion to pulverized coal firing. Fan casings are big enough to take larger rotors for future conversion to coal

480-VOLT LOAD CENTER divides into air-circuit breaker and combination-starter sections. Circuit-breaker sections serve loads 25 hp and up; combination starters supply loads under 25 hp. Total, 8 centers



4160-VOLT SWITCHGEAR supplies all motors larger than 250 hp. Circuit-breakers can interrupt 250,000-kva 3-phase faults. All feeder overcurrent, bus differential current relays located in panels

PRINCIPAL POWER-PLANT EQUIPMENT

POWER-GENERATING EQUIPMENT:

Main turbine-generators, 3 — General Electric Co
Tandem-compound, double-flow, 100,000/111,000-kw, 1800-psig, 950-F, 1.5 in 3.0 in. Hg abs, 3600-rpm, 26-stage, 5 bleed points, 1 blanked off, 129,375 kva at 15-psig H_2 pressure

House turbine-generators, 3 — General Electric Co
Single-automatic-extraction condensing, 7500/9375-kw, 1300-psig, 950-F, 4-in.-Hg abs, 3600-rpm, 6-stage, 10,714-kva at 0.7 pf, air-cooled

Main condensers, 3 — Ingersoll-Rand Co
50,000 sq ft surface, single pass, divided waterbox, deaerating and reheating hotwell, 7796 aluminum brass tubes, 28-ft effective length

Condenser tubes — American Brass Co; Phelps Dodge Copper Products Corp; Scovill Manufacturing Co; Yorkshire Copper Works, Ltd

Circulating-water pumps, 6 — Ingersoll-Rand Co
Vertical, single-stage, mixed-flow, enclosed-shaft, bottom-suction, 44,800-gpm at 21-ft total head

Circulating-pump drivers, 6 — Westinghouse Electric Corp

Main condensate pumps, 6 — Ingersoll-Rand Co
Vertical, centrifugal, 5-stage, 1600 gpm at 2115-ft total head

Condensate-pump drives, 6 — Westinghouse Electric Corp
125-hp motor, 440-v, 1175-rpm

Main steam-jet air ejectors, 3 — Ingersoll-Rand Co
Two-element, 2-stage

House condensers, 3 — Westinghouse Electric Corp
Single-pass, radial-flow, divided waterbox, deaerating hotwell, 4000 sq ft, priming ave ejector for waterbox

House condenser tubes — American Brass Co

House condensate pumps, 6 — Westinghouse Electric Corp
Horizontal, centrifugal, 2-stage, 100 gpm at 2115-ft total head, 20-hp motor drive, 440-v, 1750-rpm

House steam-jet air ejectors, 3 — Westinghouse Electric Corp
Two-element, 2-stage

Condenser vacuum pumps, 2 — Nash Engineering Co
520 cfm at 15-in. vacuum

Vacuum pump drives, 40-hp motor, 2 — General Electric Co

FEEDWATER EQUIPMENT:

Boiler feed pumps, 5 — Ingersoll-Rand Co
Primary and secondary pumps mounted on common shaft. Primary pumps: horizontal, 3-stage, single-suction, split-casing, diffuser-type, 580,000-lb-per-hr at 950-psi differential pressure. Secondary pumps: horizontal 8-stage, single suction, solid-case, diffuser-type, 550,000-lb-per-hr at 1470-psi differential press.

Boiler feed pumps, 3 — Byron Jackson Co
Primary and secondary pumps on common shaft. Primary pump: 3-stage, single-suction, first stage has opposed impellers with double suction, horizontally split volute casing, 580,000-lb-per-hr at 950 psi differential press. Secondary pump: 9-stage single suction, opposed impellers with double suction first stage, split volute casing with solid outer casing, 550,000-lb-per-hr at 1470-psi diff press

Feed pump drives, 8 — General Electric Co
2000-hp, 4160-v, 3585-rpm, shaft-driven main oil pump, air-to-water motor cooler

Feed-pump integral oil pumps, 3 — De Laval Steam Turbine Co
11 gpm at 25-psig head

Feed-pump auxiliary oil pumps, 5 — Ingersoll-Rand Co
11 gpm at 30-psig head, ½-hp motor, 220/440-v, 3450-rpm

Feed-pump auxiliary oil pumps, 2 — Brown & Sharpe Mfg Co
Rotary gear, 6 gpm at 25 psig, ¾-hp motor, 440-v

Oil coolers, 8 — Ross Heater & Mfg Co

Feedwater heaters, 3 — Griscom-Russell Co
Closed, horizontal U-tube, 4-pass, 5/8-in. OD 18 BWG cupro-nickel tubes, 400-psig shell, 700-psig tube, with desuperheater and internal drain cooler

Feedwater heaters, 3 — C F Braun & Co
Closed, horizontal U-tube, 2-pass, ¾-in. OD 18 BWG cupro-nickel tubes, 150-psig shell, 700-psig tubes, internal drain cooler

Feedwater heaters, 3 — C F Braun & Co
Closed, horizontal U-tube, 4-pass, with ¾-in. OD, 18 BWG cupro-nickel tubes, 150-psig shell, 700-psig tube, internal drain cooler

Feedwater heaters, 3 — Griscom-Russell Co
Closed, horizontal U-tube, 4-pass, 5/8-in. OD 18 BWG admiralty tubes, 250-psig tube

Deaerating feedwater heaters, 3 — Cochrane Corp
Direct-contact tray type, 2 vent condensers each, 6300-gal storage capacity, 1,176,870 lb-per-hr maximum flow

Heater drip pumps, 3 — Ingersoll-Rand Co
Horizontal centrifugal, 2-stage, 330-gpm, 242-F, 97-ft head

Heater-drip-pump drivers, 3 — General Electric Co
Electric motor, 440-v, 1745-rpm, 15-hp

Heater drip pumps, 3 — Worthington Pump & Machinery Corp
Horizontal centrifugal, 2-stage, 300 gpm, 285 F, 170 ft total head

Heater-drip-pump drive, 3 — Westinghouse Electric Corp
25-hp motor, 440-v, 1745-rpm

Evaporators, 2 — American Locomotive Co
Double effect (4 shells) horizontal, 2-pass, ¾-in. OD 20-ft 18-BWG-20 cupro-nickel tubes, 1365-sq-ft heating surface per shell, 61,000-lb-per-hr vapor output per double-effect set

Evaporator condensers, 2 — American Locomotive Co
Horizontal, shell and tube, 2-pass, ¾-in. OD 16-ft 18 BWG admiralty tubes, 1647 sq ft heating surface

STEAM-GENERATING EQUIPMENT:

Boilers, 6 — Combustion Engineering–Superheater Inc
Three-drum, bent-tube, radiant, completely watercooled furnace, 475,000 lb-per-hr continuous, 550,000 lb-per-hr for 2 weeks, 1405 psig, 950 F, 34,700-cu ft furnace volume, 25,849 sq ft waterwall surface

Oil and gas burners, 54 — Peabody Engineering Co
9 forced draft registers per boiler, 9 gas-electric igniters per boiler, 9 swing front combination gas and wide-range oil burners per boiler with 4050 lb oil per hr, each arranged at 3 levels

Superheaters, 6 — Combustion Engineering–Superheater, Inc
3-stage, 26,390 sq ft heating surface, superheat control by dual gas bypass dampers

Economizers, 6 — Combustion Engineering–Superheater, Inc
2-section, horizontal finned tubes, 8880-sq-ft surface per section, 430 F inlet, 489 F outlet water (oil fired)

Air preheaters, 6 — Air Preheater Corp
Ljungstrom regenerative, vertical shaft, 69,800 sq ft

Steam air heaters, 6 — Buffalo Forge Co
Extended surface coils, 2590 sq ft heating surface, 512,000-lb-per-hr ia at 30 F

Forced-draft fans, 6 — American Blower Corp
Inlet vane control, outlet dampers, oil, gas or pulverized coal duty, 62.5-in. wheel diameter, 1167 rpm, 180,000 cfm at 100 F and 18-in., water

Forced-draft fan drive, 6 — Westinghouse Electric Corp
700-hp motor, 4160 v, 1200 rpm, 1 surface cooler per motor needing 35 gpm water at 75 F

Induced-draft fans, 6 — American Blower Corp
Inlet louver dampers, outlet dampers, for oil or gas duty, 90.3-in. wheel diameter, 490 rpm, 313,000 cfm at 420 F and 10.1 in. water, watercooled bearings

Induced-draft fan drives, 6 — Westinghouse Electric Corp
900-hp motor, 4160 v, rpm, 1 surface cooler per motor needing 50 gpm water at 75 F

Soot blowers — Diamond Power Specialty Corp
Manually operated, steam Superheater sections: 12 retractable units on upper side walls, 10 revolving units on side walls. Economizer sections: 4 revolving units on rear wall, 4 stationary units on each rear and side wall; furnace (future): 8 wall boxes on front, side and rear walls for possible future installation of retractable soot blowers

Automatic control systems — Bailey Meter Co
Combustion and feedwater controls for (1) combustion (2) steam temperature (3) fuel-oil temperature (4) air temperature leaving steam air heater (5) feedwater flow (6) feedwater pressure and pump regulation

INSTRUMENTS AND METERS:

Conductivity recorder — Minneapolis–Honeywell Regulator Co

Liquid-level controllers — Clinton Controls Div, Black, Sivalls & Bryson; Hammel–Dahl Co; Mason–Neilan Regulator Co; Fisher Governor Co

Draft gages — Bailey Meter Co

Liquid-level indicators — Taylor Instrument Co's; Yarnall–Waring Co

Manometers — Meriam Instrument Co

pH recorders — Leeds & Northrup Co

Differential pressure indicators — Bushnell Controls & Equipment Co

Pressure control — Fisher Governor Co

Pressure gages — Pacific Coast Instrument Co; Trident Engineering Co

Pressure snubbers — Operating & Maintenance Specialties Co

Pressure and temperature recorders — Foxboro Co

Sight-flow indicators — Fischer & Porter Co

Limit switches — General Electric Co

Mercury switches — The Mercoid Corp

Thermo switches — Fenwal, Inc

Tank gages — Shand & Jurs Co

Temperature control and control valves — Mason–Neilan Regulator Co

Temperature indicators — Minneapolis–Honeywell Regulator Co

Industrial thermometers — Palmer Thermometers

Water-flow meters — Neptune Meter Co

Water-jet ejector — Schutte & Koerting Co

Turbodimeter — General Electric Co

MISCELLANEOUS HEAT EXCHANGERS:

Bearing cooling water, 3 — Ross Heater & Mfg Co, Inc
1500 sq ft surface, ¾-in. 18 BWG aluminum brass tubes

Fuel-oil heaters (primary) — Southwestern Engineering Co
Horizontal, oil through tubes, 272 sq ft surface

Fuel-oil heaters, 9 (secondary) — C F Braun & Co
Horizontal, oil in tubes, 2150 sq ft surface

Primary fuel-oil-heater condensate cooler, 1 — E C Cooley Co

Sampling coolers, 37 — Hagan Corporation

Service-tank recirculating heaters, 2 — Southwestern Engineering Co

Storage-tank internal suction heaters, 2 — Southwestern Engineering Co

MISCELLANEOUS PUMPS:

Bearing cooling-water pumps, 4 — Worthington Pump & Machinery Corp
Vertical turbine type, 5-stage, 480-gpm, 120 F at 115-ft total head

Bearing-water pump drives, 4 — Westinghouse Electric Corp
15-hp motor, 440-v, 1745-rpm

Boiler test pump, 1 — Worthington Pump & Machinery Corp
Vertical triplex type, 3.3 gpm at 3500 psig

Boiler test pump drive, 1 — Westinghouse Electric Corp
10-hp motor, 440-v, 430-rpm

Boiler wash pump, 1 — Worthington Pump & Machinery Corp
Single-stage centrifugal, 250 gpm at 128.1 head diff, 30-hp motor drive, 440-v, 3500-rpm

Boiler-water transfer pumps, 2 — Worthington Pump & Machinery Corp
Single-stage centrifugal, 400 gpm at 66.5-psig press. diff, 25-hp motor drive, 440-v, 3500-rpm

Burner cleaning pump, 1 — Aurora Pump Co
Turbine type, 15 gpm at 200-psi press. diff, 7.5-hp motor drive, 220/440-v, 3600-rpm

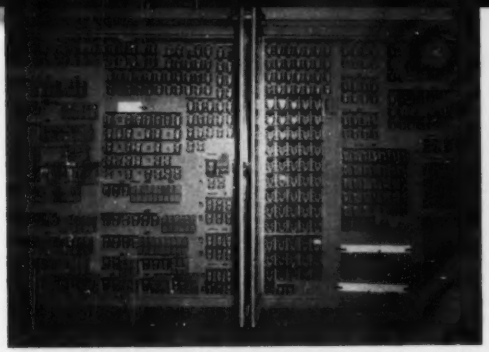
Closed drip-tank pumps, 3 — Ingersoll-Rand Co
Centrifugal, 125-gpm, 230-F water at 330-ft total head, 7.5 motor drive, 440-v, 1750-rpm

Control-house bilge pump, 1 — Chicago Pump Co
Centrifugal, 50 gpm at 10-ft total head, ½-hp motor drive, 220-v, 1750-rpm

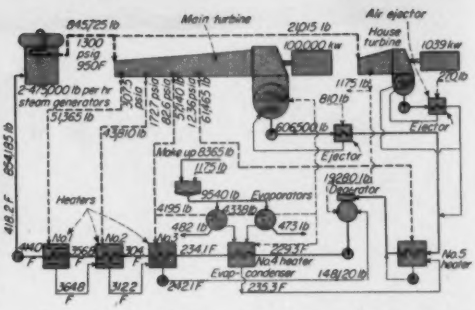
Distilled-water pumps, 3 — Ingersoll-Rand Co
Horizontal single-stage centrifugal, 300 gpm at 175-ft total head, 30-hp motor drive, 440-v, 3450-rpm

Water-tank booster pump, 1 — Peerless Pump Div, Food Machinery & Chemical Corp
Horizontal centrifugal, 100-gpm at 114-ft head, 5-hp motor drive, 440-v, 3450-rpm

Evaporator feed pumps, 4 — Allis Chalmers Mfg Co
Centrifugal, pedestal type, 150 gpm of 230-F water at 175-ft total head, 15-hp motor drive, 440-v, 3500-rpm



CONTROL-ROOM ALARMS and annunciators require total of five relay cabinets, two of them shown here, below control room. The 125-v dc station battery distribution system powers annunciator system



UNIT HEAT BALANCE includes house turbine floating at low load. Net heat rate figures at 10,935 Btu per kwhr. Evaporators may be used in double-effect arrangement or singly. No. 2 has no evaporator

Contra Costa Steam Plant, Antioch, Calif., Pacific Gas & Electric Co, Units No. 1, 2 and 3

Fire pumps, 2000 gpm, 2 — Byron Jackson Co

Fire-pump drive, 250-hp motor, 1 — General Electric Co

Fire-pump drive, 1 — Westinghouse Electric Corp
250-hp steam turbine, 175-psig steam, 3580-rpm

Fuel-oil recirculating pumps, 4 — H K Porter Co
Horizontal, balanced quadruplicate screw, external gear and bearings, 300 gpm at 226-ft total head and 12,000 sss viscosity

Recirculating pump drives, 4 — Westinghouse Electric Corp
25-hp electric motors, 440-v, 1150-rpm

Fuel-oil transfer pumps, 2 — Warren Steam Pump Co
Horizontal balance quadruplicate screw, external gear and bearing 1000 gpm at 250-ft total head and 5000 sss viscosity

Transfer-pump drives, 2 — Westinghouse Electric Corp
100-hp motor, 440-v, 690-rpm

Gland-seal water-return pumps, 3 — Worthington Pump & Machinery Corp
Vertical turbine type, 6-stage, 168 gpm of 180-F water at 165-ft total head, 10-hp motor drive, 440-v, 1750-rpm

Lube-oil filter pumps, 6 — De Laval Steam Turbine Co
Rotary, 3 at 11.2 gpm, 25 psi diff press. for main units, 3 at 2.7 gpm, 25-psi diff press. for house units, ½-hp motor drive, 440-v, 1150-rpm

Lubricating-oil transfer pump, 1 — H K Porter Co
Rotary-gear type, gear-in-head, 90 gpm at 50-psi diff press., 7.5-hp motor drive, 440-v, 1150-rpm

Primary fuel-oil pumps, 12 — De Laval Steam Turbine Co
Triple rotary screw, floating driving screw with two idlers, 90 gpm at 1970-ft total head and 3000 sss viscosity, 75-hp motor drives, 440-v, 3580-rpm

Secondary fuel-oil pumps, 12 — United Iron Works
4-stage centrifugal, 77 gpm at 750-ft total head, 40-hp motor drive, 440-v, 3550-rpm

Primary fuel-oil heater pumps, 4 — Aurora Pump Co
Turbine-type, 2-stage, 7 gpm at 197-ft total head, 3-hp motor drive, 220/440-v, 1740-rpm

Primary fuel-oil heater drip-transfer pumps, 3 — Peerless Pump Div, Food Machinery & Chemical Corp
Centrifugal, 50 gpm of 165-F water at 59.1 total head, 1.5-hp motor drive, 440-v, 3550 rpm

Secondary fuel-oil heater-transfer pumps, 3 — Worthington Pump & Machinery Corp
Centrifugal, 15 gpm of 180-F water at 35.5-ft total head, 1/3 hp-motor drive, 440-v, 1750-rpm

Raw-water makeup pumps, 4 — Worthington Pump & Machinery Corp
Vertical turbine type, 210 gpm at 180-ft total head, 15-hp motor drive, 440-v, 1750-rpm

Screen wash pumps, 2 — Food Machinery & Chemical Corp
Deepwell, turbine type, 2500 gpm, 240-ft head, 230-hp motor drive, 440-v, 1780-rpm

Screen well pumps, 2 — Byron Jackson Co
Vertical turbine type, 500 gpm, 280-ft head, 50-hp motor drive, 440-v, 1750-rpm

Solvent injection pump, 1 — Hills-McCanna Co
Positive displacement, single-cylinder, single-acting, 7 gph at 25-psig discharge, 1/3-hp motor, 440-v, 1725 rpm

Station service-water pumps, 4 — Ingersoll-Rand Co
Horizontal single-stage centrifugal, double suction, split casing, 6800 gpm at 115-ft total head

Service-pump drives, 4 — Westinghouse Electric Corp
300-hp electric motor, 4160 v, 1182 rpm

Oily-water booster pumps, 2 — Chicago Pump Co
Vertical nonclog sump type, 1000-gpm, 25-ft head, 15-hp motor drive, 440-v, 1150-rpm

Drainage booster pumps, 3 — Economy Pumps, Inc

Transformer oil pump, 1 — Pacific Pumping Co

Vacuum priming pumps, 2 — Nash Engineering Co
70 cfm at 25-in.-Hg vacuum, 7.5-hp motor, 440-v, 1180-rpm

COMPRESSED AIR SYSTEMS:

Service air compressors, 2 — Chicago Pneumatic Tool Co
Horizontal, tandem, 2-stage, 216 cfm at 130 psig, 327 rpm, intercooler, aftercooler, air filter-silencer

Instrument air compressors, 5 — Ingersoll-Rand Co
Horizontal, single-stage, double-acting, water jacketed, 294-cfm at 100 psig, 300-rpm, aftercooler, air filter-silencer

Instrument air dryer, 1 — Industrial Corp
Dual tower, activated alumina desiccant for instrument and control air

Air filters and reducing manifolds, 12 — Bailey Meter Co

PIPING:

All steam and boiler feed — Midwest Piping & Supply Co

Circulating water, cast iron — U. S. Pipe & Foundry Co

Fire lines — Grinnell Co of the Pacific; P E O'Hair & Co

Control-air copper tubing — Midwest Piping & Supply Co.

Cooling coils — Hagan Corp

Expansion joints — Badger Manufacturing Co; Chicago Metal Hose Corp; Zallea Brothers; Garlock Packing Co; Yarnall-Waring Co

Filter — Cuno Engineering Corp

Expansion joints — Badger Manufacturing Co; Chicago Metal Hose Corp; Zallea Brothers; Garlock Packing Co; Yarnall-Waring Co

Funnels — Benner Newman Inc

Steam-sampling tubes — C C Moore & Co

Strainers — Yarnall-Waring Co; Elliott Co; Henry Vogt Machine Co

Traps — Yarnall-Waring Co; Strong, Carlisle & Hammond Co; Wright-Austin Co; Armstrong Machine Works

Insulation, piping, ducts & vessels — Armstrong Cork Co

VALVES:

High-pressure gate and check valves — Chapman Valve Mfg Co; Crane Co; Wm Powell Co

Steel gate, globe and check valves — Chapman Valve Mfg Co; Stockham Valve & Pipe Fittings Co; Crane Co; Walworth Co; Wm Powell Co; Fairbanks Co; Edward Valves, Inc; Ohio Injector Co; Manning, Maxwell & Moore, Inc; Pacific Valves, Inc

Instrument valves — Dragon Manufacturing Co; Edward Valves, inc

Bleeder check valves — Atwood & Morrill Co

Boiler blowoff valves — Yarnall-Waring Co

Iron and bronze valves — Chapman Valve Manufacturing Co; Wm Powell Co; Crane Co; Walworth Co; The Fairbanks Co; Stockham Valves & Fittings Co

Solenoid trip valves — Auto Switch Co

Relief valves — Manning, Maxwell & Moore, Inc

Butterfly valves — Bushnell Controls & Equipment Co; Henry Pratt Co

Pressure reducing and control valves — Fisher Governor Co

Transfer valves — Bailey Meter Co

Pressure trip valve — Ruggles-Klingemann Mfg Co

Feed-pump recirculating-control valves — Mason-Neilan Regulator Co

TANKS AND RECEIVERS:

Service-air receivers, 2 — Chicago Pneumatic Tool Co
120-psig, 3-ft dia, 9-ft high

Instrument air receivers, 5 — Ingersoll-Rand Co
115-psig, 4-ft dia, 12-ft high

Bearing-cooling-water return tank — Atlas Steel Products Co

Blowoff tanks, 2 — McDonough Steel Co

Boiler-water transfer tank — Consolidated Western Steel Corp

Chemical injection drums, 3 — Babcock & Wilcox Co

Chemical mixing tanks, 3 — Independent Iron Works, Inc

Closed drip tanks, 3 — California Steel Products Co

Continuous blowdown flash tanks, 3 — Santacco Tank & Welding Co

Distilled-water surge tanks, 2 — Consolidated Western Steel Corp

Elevated water-storage tank — Chicago Bridge & Iron Co

Evaporator and freshflow flash tanks, 2 — Atlas Steel Products Co

Gland seal return tanks, 2 — Atlas Steel Products Co

Lube-oil storage tank — Independent Iron Works, Inc

Oil skim tanks, 4 — Berkely Steel Construction Co, Inc
2.5-ft wide, 10-ft long, 5-ft high, floating cover

Oil separator, 1 — Consolidated Western Steel Corp

Primary fuel-oil-heater condensate tanks, 2 — San Jose Steel Co

Vacuum priming tank, 1 — McDonough Steel Co

Transformer-oil storage tank, 2 — California Steel Products Co

VENTILATION AND AIR CONDITIONING:

Air-conditioning units, 4 — General Electric Co
10 tons, self-contained (loss condensers), Freon, 3 units with one row steam-heating coils, 1 unit with 75-kw electric finned strip heaters, 10-hp compressor motor, 1.5-hp fan

Evaporating condensers, 4 — American Locomotive Co
Includes 1/3-hp circulating-water pump motor, 1-hp fan

Air washers, 10 — Buffalo Forge Co

Ventilation supply fans, 10 — Buffalo Forge Co

Ventilation exhaust fans, 20 — Buffalo Forge Co

Ventilators, 2 — H H Robertson Co

Ducts — Atlas Heating & Ventilating Co

Air filter, 4000-cfm — Fred W Kolb

Miscellaneous exhaust fans, 7 — Westinghouse Electric Corp

Vent fan — Sturtevant Div, Westinghouse Electric Corp
For burner-cleaning station

MISCELLANEOUS EQUIPMENT:

Turbine-bay cranes, 75-ton, 2 — Cyclops Iron Works

Auxiliary-bay crane, 25-ton, 1 — Moffett Mfg Co

Machine-shop crane, 10-ton, 1 — Moffett Mfg Co

Traveling platform, 4 — Moffett Mfg Co
For boiler burner maintenance, motor operated

Chlorinators, 3 — Wallace & Tiernan Products, Inc

Passenger elevator, 1 — Pacific Elevator & Equipment Co

Freight elevator, 1 — Pacific Elevator & Equipment Co

Hydraulic fish lift, 1 — Gilmore Steel & Supply Co

Lubricating-oil purifier — Sharples Corp of California
Portable, 450-gph, 3-hp 230/440-v 3475-hp motor, 10-kw heater

Turbine lube-oil filters, 6 — Bowser, Inc

I-g CO_2 fire-protection equipment — Cardo Western, Inc

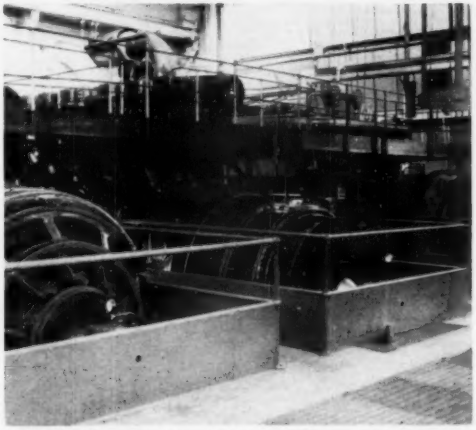
Water-treating plant — Graver Water Conditioning Co
Hot process with sludge-blanket type reactor, vent condenser, two 1650 gal chemical-feed tanks each with 2-hp 1125-rpm agitator motors; 3 chemical-feed pumps with 1.5-hp 1800-rpm motors; 3 sample coolers, control valves, flowmeters, solenoid-operated dechlorizing valve, 125,000-lb-per-hr maximum continuous output

Engineers and Constructors — Bechtel Corporation

CEILING-MOUNTED fans for one of the two air-cooled heat exchangers in Cooper-Bessemer's closed system for cooling engine jacket water. Each fan is rated at 108,000 cfm, and each radiator dissipates an estimated 4.5 million Btu per hr

To cut winter heating costs and ventilate in summer, this plant . . .

Put Diesel Heat To Work



WASTE HEAT from engines totaling 7320 connected horsepower is used for supplemental winter heating of a plant building

► DIESEL WASTE HEAT and its removal are all too often accepted as a necessary evil. Cooling equipment is provided as a matter of course without thought of the heat-recovery possibilities that offer attractive dividends in many industrial plants.

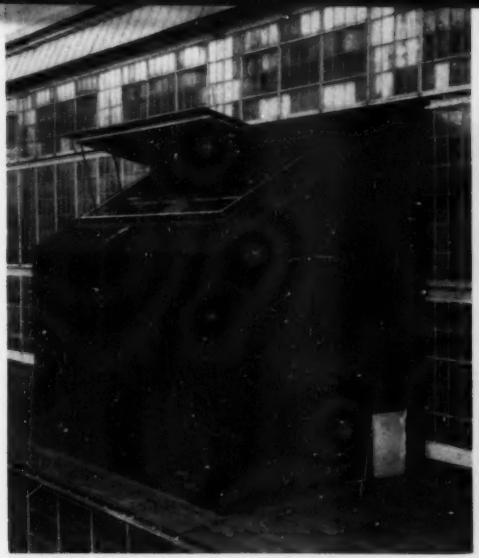
To prove these dollar-saving opportunities, the Cooper-Bessemer Corp devised and set up, in its Grove City, Pa. plant, a system to make use of engine jacket-water heat for plant heating. The system has been operating for over a year, and has already saved more than double the $2000 installation cost of extra pumps and piping.

With two air-cooled radiators installed in the engine-erection building adjoining the powerhouse, waste heat is used as a supplement to the regular heating system during the winter months. In summer, fans blow heat out to the atmosphere, setting up welcome ventilation.

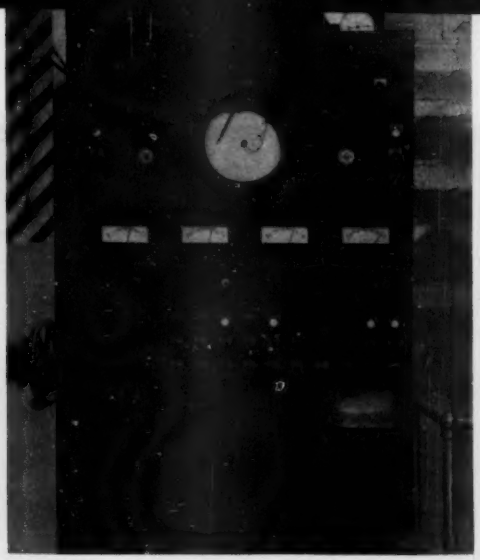
Of the nine engines in the powerhouse, totaling 7320 hp, the original cooling system was designed to handle four, involving 4720 hp and a heat dissipation of 9.2 million Btu per hr. Original estimates of heat-dissipation factors and cooling capacity were so conservative, however, that engineers soon found the system could handle all nine engines without adding any more equipment.

Required reduction of jacket-water temperature is 160 to 148 F. And radiators are rated conservatively at 4.5 million Btu per hr each, based on 90-F air. The fans, one under each radiator, are 15-hp 4-blade variable-speed jobs, each rated at 108,000 cfm.

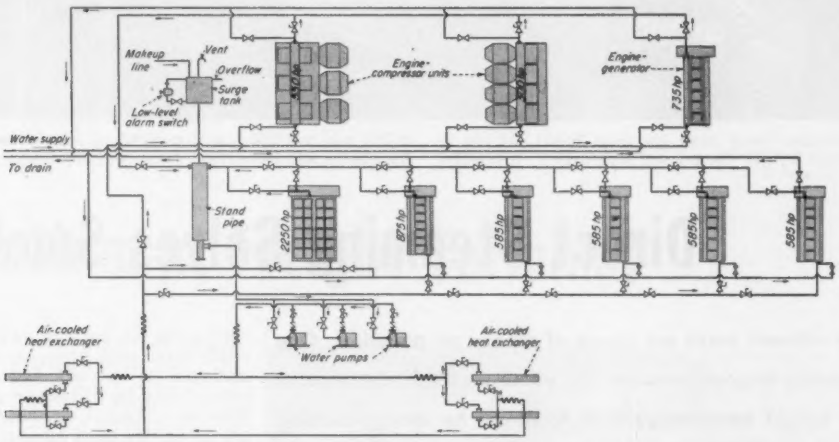
Both radiators are mounted horizontally on side-bay ceilings, 35 and 50 ft above the floor. Jacket water is piped



MOTOR-OPERATED louver over radiator unit. It is closed in winter for plant heating, opened in summer for ventilation



AUXILIARY panel in powerhouse, with all controls and alarms for cooling system, has emergency alarm for power failures



SCHEMATIC piping diagram of entire heat-utilization cooling system in Cooper-Bessemer's Grove City, Pa. plant. Larger units on upper level are engine compressors, while remainder are all engine generators. The units total 7320 connected hp

from the powerhouse 100 ft to one radiator, 300 to the other.

To vent heat to the atmosphere, a pair of center-opening doors, or louvers, open through the roof over one of the radiators, while a single side-opening door serves the other.

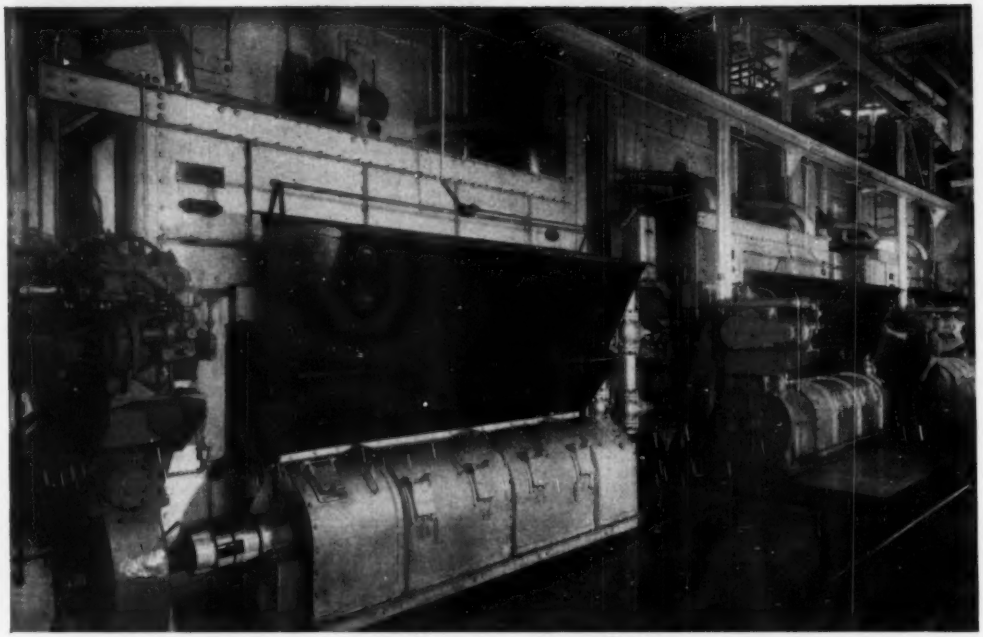
Complete cooling-system controls are centralized on one common auxiliary panel in the powerhouse. Included is an alarm system for high- and low-water temperature and low-water level. If power to these circuits fails, a separate horn alarm circuit is energized.

The building's regular heating system is thermostatically controlled. Thus, introduction of waste heat automatically reduces demand from the regular fuel-consuming heat source. It's estimated that 6 to 7 million Btu per hr are needed to heat the building in zero weather. Of this, the radiators supply an average of 5 million Btu per hr during the winter months—a considerable saving.

For a 1900-hr heating season, Cooper-Bessemer engineers estimate a saving of about $5000, based on prevailing local fuel prices. Since the amount spent for heat-utilization piping and equipment over the necessary cost of the cooling system alone was only $2000, this job paid off in a hurry.

Here are some other advantages not to be discounted: The hazard of costly winter freeze-ups is eliminated. There's not even any need for precautionary expense. Moreover, the ceiling-mounted radiator units don't take up any floor space.

The waste-heat recovery system was designed by Cooper-Bessemer engineers cooperating with the P C McKenzie Company, the Fluor Corporation and the Griscom-Russell Company.



1 This modern steam plant has three boilers, 35,000 lb per hour, with air heaters and superheaters. It operates at 250 psia and 550-F total temperature, supplies steam to direct-steam cold locomotives. Firing is by chain-grate stokers

Direct Steaming Solves Smoke

Big-city railroad yards are source of serious air pollution. One of Canada's largest railroads has eliminated this nuisance at a new freight terminal yard in Montreal by direct-steaming of cold locomotives from recently built central steam plant

By JOHN M DYKE,
Assistant Engineer, Power Plants, Canadian Pacific Railway Company

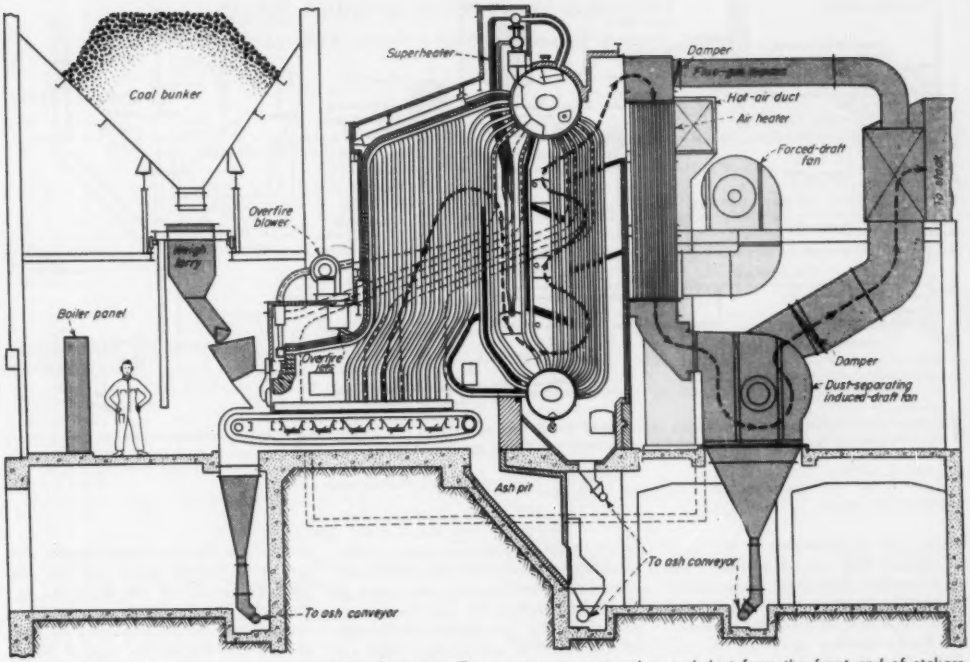
► THE CANADIAN PACIFIC RAILWAY performed an almost legendary role in the pioneering days of Canada. Now that the Dominion is firmly established as a great industrial nation, this famous railway is playing an important part in the current surge of industrial development by adopting a farsighted policy in its relations with the communities where it operates. One of the ways of implementing this policy is to avoid pollution of the atmosphere and waterways.

Air-Pollution Causes. When hauling a train under normal conditions a steam locomotive emits little smoke, and any that does occur is generally of short duration. In a freight terminal, conditions are vastly different. In addition to regrouping of trains, servicing and repair of locomotives is a major task. Normally each steam locomotive going to the engine house for servicing has its fires dumped and sometimes its boiler emptied, ready for inspection.

Relighting the fire in a cold boiler usually causes black smoke due to poor combustion in the cold firebox and boiler during the lighting-up period. When several engines are steaming up and the light-up man's attention is divided among them, smoke is likely to occur.

These conditions were taken into account when Canadian Pacific Railway planned its recently completed freight terminal at Cote St. Luc, a Montreal suburb. The immediate neighborhood is now sparsely populated, but the rapid growth of the city indicates that the yard may be in a built-up district before long. So, from the beginning of this terminal's design it was decided to eliminate the smoke nuisance by direct steaming of locomotives.

Preventing Air Pollution. Direct steaming to prevent air pollution is comparatively new, and St. Luc plant is the fourth and most modern in Canada to use this method. By it, locomotives are charged with steam and water at



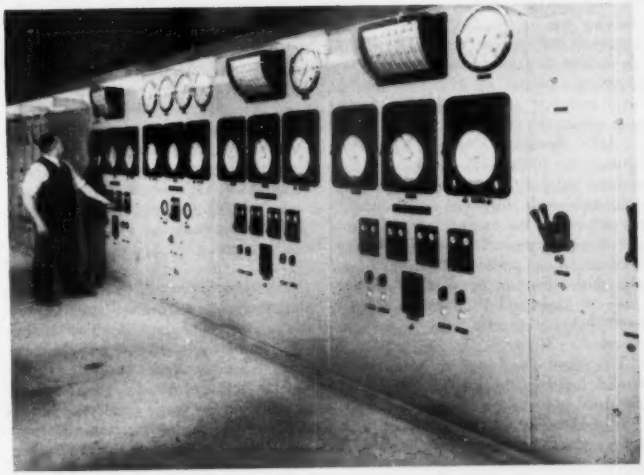
2 Boilers are a 2-drum type with watercooled furnaces. To keep the air pollution at a minimum, a steam-jet vacuum system removes ashes and dust from the front end of stokers, ashpits, last pass of the boilers, and the induced-draft fans

Problem at Freight Terminal

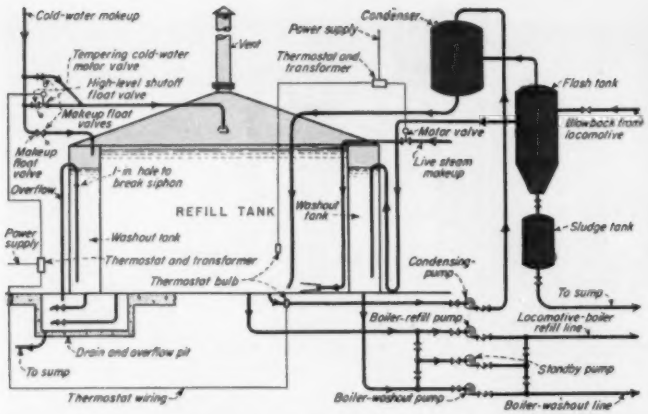
the correct temperature and pressure from a central plant so smoke that occurs when firing in a cold firebox is practically eliminated. Steam is generated at high efficiency without smoke in a modern plant, and locomotives brought to steaming pressure much faster, more quietly than by normal firing method.

Main Boiler Plant. Each of the three boilers has a capacity of 35,000 lb per hr at 250 psi and 550-F total temperature and is fired by a chain-grate stoker. The boilers are the 2-drum type with a steam drum of ample volume to take care of any sudden peak demand. For efficient combustion, a completely watercooled furnace has a long, high front arch and a short rear one. Overfire-air jets are in the nose of the front arch, but experience shows that they are required only during poor firing conditions like rapidly changing load, poor coal, or uneven fuel bed.

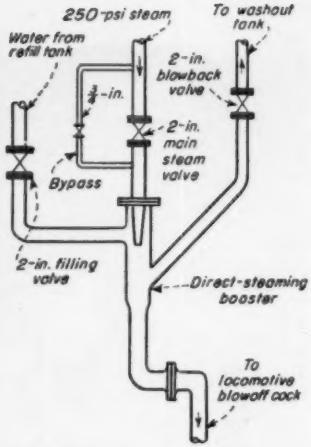
Plant Auxiliaries. With present high fuel costs, air heaters are a "must." Air ducts are so arranged that the air



3 To simplify plant operation all the boiler automatic combustion controls, meters, lighting and power switches and controls are mounted upon these panels



4 Direct-steaming and washout system is designed to recover heat from the blowdown water as well as supply washout and clean hot water to the locomotives



5 Direct-steaming booster connects to washout, refill-water and steam lines

heaters can be bypassed, as in Fig. 2, for natural-draft operation when lighting up and on light loads. Superheaters are of the pendant type and provide 145-F superheat at rated boiler capacity. Dust-collecting induced-draft fans were selected to avoid soot emission from the stack. This type is suitable for chain-grate stokers from which the emission is coarse. Dust-collection capacity is provided well in excess of that required by code under the most adverse fuel-bed conditions.

There are three centrifugal boiler-feed pumps, two driven by turbine and one by electric motor. Two have sufficient capacity for plant operation, leaving one as standby. Normally, two steam-driven pumps are used. Boiler feedwater is taken from a deaerating feedwater heater at 220 F. There is also installed a blowdown heat-recovery system to reduce heat loss.

Ash Handling. Ashes from the stoker rear ends collect in pits of sufficient capacity to require dumping only once each shift. The small amount of ash from the stoker front collects in sifting hoppers. To reduce air pollution as far as possible, two intakes to the dust-collecting system in the last pass of each boiler remove dust and soot that are thrown out of the gas stream.

This dust, if allowed to accumulate, would increase the dust emission and the load on the dust-separating fans. Dust-separating induced-draft fans also have a duct leading to the ash-removal system to assist in keeping boiler operation dustfree.

Each ash-collecting intake connects to the steam-jet conveyor system, which discharges the ashes to a cyclone separator. From the separator, the ashes go to a 25-ton storage bin and the mixture of air and flue gas discharges through an air washer to atmosphere. Ashes are discharged to railway cars through a dust-suppression chute that has water sprays. Thus ash disposal causes a minimum of dust nuisance.

Combustion Control, Meters. Control of combustion is completely automatic. A central panel mounts (1) all meters (2) controls for each boiler and (3) master control to operate all three in parallel as a unit.

Adjacent to the controls are the indicating instruments and gages, and the smoke recorder with an alarm to warn the operator if stack-haze density approaches the limit the city smoke ordinance permits. At one end of the panel are electrical controls for the boiler auxiliaries and plant machinery with indicating lights showing equipment in operation. At the other end is the lighting and small motor's panels. Thus all controls are centralized at a single location to simplify operation, Fig. 3.

Other Equipment. In addition to the main steam-generating equipment, there are in the same building two motor-driven air compressors to supply compressed air for yard work, the main electric-service switches, power transformers and a storage battery. The latter supplies dc power for motor controls and lights if the main power source fails.

Washout Operations. At Cote St. Luc the boiler plant supplies 250-psi steam to a direct-steaming header that circles the engine house and has connections for 25 of the 37 stalls, the remaining 12 being used to service diesel locomotives. At the middle of its outer radius, but outside the engine house, is a large hot-water storage tank with pumps and heat-recovery equipment, Fig. 4, used for washing out and refilling locomotives. At each steam-locomotive stall is a direct-steaming booster from which hangs a pipe fitted with flexible joints so it can be connected to the blowoff cock of the incoming locomotive. This booster, Fig. 5, connects to the direct-steaming main and, by using chain-operated valves, it can be connected to the boiler washout and refillling lines.

After a locomotive is uncoupled from an inbound freight train, it takes coal and water and dumps its fire before going into the engine house. If boiler washout or repairs are required, it is emptied.

Heat Recovery. As shown in Fig. 4, blowdown from a locomotive first goes to the flash and sludge tank. Here the steam is flashed off and condensed, and the sludge separated and discharged to the sump. Hot water goes to the washout tank where its heat assists in keeping water in the refill tank at correct temperature. Water from the washout tank is pumped out as required to flush out sludge remaining in the boilers. A final purge of clean hot water may be necessary to complete cleaning out the boiler. This procedure obtains maximum heat recovery with minimum waste of water, and reduces boiler maintenance.

PRINCIPAL POWER-PLANT EQUIPMENT

St. Luc Yard—Canadian Pacific Railway Co, Montreal, Quebec

STEAM GENERATION:

Boilers, waterwalls, air heaters ..... Dominion Bridge Co, Ltd
Boilers, three, 2-drum, integral furnace; heating surface, 5400 sq ft; air heaters, tubular, 2500 sq ft; max gas temperature in, 610 F; out, 450 F; max air temperature out, 280 F; max continuous steaming capacity 35,000 lb per hr; design steam conditions, 300 psig, 550-F total temp; operating conditions, 250 psig, 550 F; furnace volume, 1500 cu ft; heat release per cu ft per hr, 31,300 Btu
Boiler refractories ..... A P Green Fire Brick Co, Ltd
Boiler heat insulation ..... Asbestos Covering Co, Ltd
Boiler ducts and breechings ..... Dominion Bridge Co, Ltd
Superheaters ..... Combustion Engineering Corp, Ltd
Stack ..... Custodis Canadian Chimney Co
Radial brick, 150 ft high, 8-ft diameter at top

COMBUSTION EQUIPMENT:

Automatic combustion controls ..... Bailey Meter Co, Ltd
Soot blowers, air puff (Diamond) ..... F S B Heward & Co, Ltd
Stokers, 3, chain grate ..... Combustion Engineering Corp, Ltd
Width, 9 ft; length, 15 ft 2 in. between shaft centers; grate area, 108 sq ft; coal-burning rate, 32 lb per sq ft per hr
Forced-draft fans, 3 ..... Sheldons Engineering, Ltd
Dual driven, 15,000 cfm, 3.75 in. wg at 80 F
Electric motors, 3 ..... Canadian General Electric Co, Ltd
Squirrel cage, 15 hp, 1160 rpm, 550 v
Steam turbines, 3 ..... Coppus Engineering Co
3535 to 1160 rpm, steam conditions 225 psig, 550 F, 5-psig back-pressure
Induced-draft fans, 3, dust separator ..... Sheldons Engineering, Ltd
Dual driven, 26,000 cfm, 5.0 in. wg at 460 F
Electric motors, 3 ..... Canadian General Electric Co, Ltd
Squirrel cage, 30 hp, 860 rpm, 550 v
Steam turbines, 3 ..... Coppus Engineering Co
3535 to 860 rpm, steam conditions, 225 psig, 550 F, 5-psig backpressure
Overfire-air blowers ..... Sheldons Engineering, Ltd

COAL AND ASH HANDLING:

Coal conveyor ..... Jeffery Mfg Co, Ltd
V-bucket elevator with horizontal travel to bunkers. Capacity 40 tons per hr
Coal-conveyor central lubricating system ..... Williams & Wilson, Ltd
Coal bunkers, three, 200 tons each ..... Dominion Bridge Co, Ltd
Coal weigh larry ..... Jeffrey Mfg Co, Ltd
Weigh-larry scales ..... Canadian Fairbanks-Morse Co, Ltd
Car puller ..... Canadian Ingersoll-Rand Co, Ltd
Ash-conveyor system and 25-ton storage tank ..... (United Conveyor) Preston Phipps Co, Ltd

VALVES AND PIPING:

Safety valves ..... Crosby Steam Gage & Valve Co
Nonreturn valves ..... Hopkinson, Ltd
Blowdown valves ..... Yarnall Waring Co
Steam and feedwater gate and globe valves ..... Crane Co, Ltd
Pressure-reducing valves ..... Mason-Neilan Regulator Co
Traps ..... Armstrong Machine Works
Overhead and underground piping (Ric-Wil) ..... F S B Heward & Co, Ltd
Piping contractor ..... Garth Co, Ltd
Pipe heat insulation ..... Herman Riggs

FEEDWATER SYSTEM:

Feedwater chemists ..... E F Drew Co
Feedwater chemical pumps ..... Bird Archer Co, Ltd
Feedwater heater (Cochrane) ..... Liquon Conditioning Corp, Ltd
Deaerating, 150,000 lb per hr, from 60 to 220 F
Water columns (Reliance) (Diamond) ..... F S B Heward & Co, Ltd
Boiler-feed pumps, 2 ..... Canadian Ingersoll-Rand Co, Ltd
One turbine driven, one motor driven, 160 gpm, 315 psig, 3450 rpm
Steam turbine, 1 ..... Coppus Engineering Co
60 hp, 3450 rpm, steam conditions, 225 psig, 550 F, backpressure 5 psi
Electric motor, 1 ..... Canadian General Electric Co, Ltd
Squirrel cage, 60 hp, 3450 rpm, 550 v
Boiler feed pump, 1 ..... Darling Brothers, Ltd
Turbine driven, 70 gpm, 315 psig, 3450 rpm
Steam turbine, 1 ..... Coppus Engineering Co

METERS:

Boiler control panels ..... Bailey Meter Co, Ltd
Steam-flow meters and draft gages ..... Bailey Meter Co, Ltd
Steam- and water-pressure gages ..... Pitanco Instruments Co, Ltd
Temperature recorders ..... Bailey Meter Co, Ltd
Smoke-density recorders ..... Bailey Meter Co, Ltd

SERVICE EQUIPMENT:

Air compressor, 1 ..... Canadian Ingersoll-Rand Co, Ltd
One, motor driven, 1800 cfm, 110 psig
Synchronous motor, 1 ..... Canadian General Electric Co, Ltd
300 hp, 320 rpm, 4000 v
Air compressor (Worthington), 1 ..... John Inglis Co, Ltd
Motor-driven, 150 hp, 520 rpm, 4000 v
Synchronous motor ..... English Electric Co, Ltd
Electric-motor controls and panels ..... Cutler-Hammer, Inc
Electric power-distribution panels ..... Electric Switchgear, Ltd
Storage batteries ..... Thos A Edison Co
Direct steaming equipment ..... Direct Steaming Co of Canada
Blowdown recovery equipment (Cochrane) ..... Liquon Conditioning Corp, Ltd
Washout and refill pumps ..... John Inglis Co, Ltd

Direct Steaming. When the locomotive is ready for service, coal from the tender is put on the grates and, about four hours before dispatch, direct-steaming is started. Valves are opened to slowly bleed steam into the boiler until it heats uniformly. Then water from the refill tank is fed in by the injector of the direct-steaming booster. Water is shut off when the level in the boiler reaches a point below normal, when only steam is supplied to increase the temperature and pressure.

Before the boiler is up to working pressure the water level may rise above normal. Then some of the water is blown back into the heat-recovery system. Then more steam is injected and the process repeated until pressure, temperature and water level in the boiler are correct. The locomotive can now move out under its own steam and if necessary stand for one-half hour or more and still move without firing. Normally, however, it is moved immediately to the light-up station. Here an oil torch is played on the coal on the grate and, because the firebox and boiler are hot a clean fire is started in a few minutes. In not more than five minutes after firing the locomotive is ready for service.

Direct-Steaming Equipment. The washout and refill storage tank, 30 ft in diameter, is completely insulated to reduce heat losses. The inner compartment is always filled with clean city water. Through the heat recovery system, supplemented by steam supplied through a thermostat-control valve, water temperature is held at about 200 F.

There are three large motor-driven centrifugal pumps for refill, washout and standby purposes. A smaller pump circulates refill water through the flash-steam condenser.

Sludge in the blowdown water from the locomotives is separated by a cyclone effect in the flash tank and the hot water discharged to the washout water tank. Sludge collects in sludge tank and is drained off to a sump for disposal. Using hot-water condensing, flash-steam recovery and insulated double tank means efficient operation.

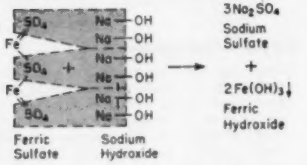
Conclusion. This plant not only eliminates the major causes of air pollution in freight-yard operations, but also makes sure that main-boiler operation is above suspicion. Aside from the better public-relations value, substantial fuel savings result, together with reduced locomotive-boiler maintenance, reduced fire hazard, a saving in engine-house labor and more rapid servicing of the engines.

Water-Softening Methods 3: Combined Treatments

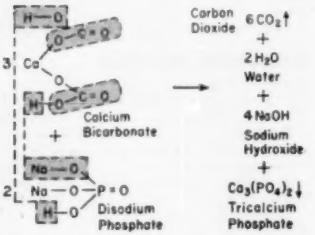
By PAUL BRINDISI
Chemical Engineer, Celco Laboratories

The in-between boiler field of fairly high operating pressures requires a high-quality makeup water—one free of suspended matter, very low in silica, practically free of dissolved gases, virtually no hardness. Here's how to supply it cheaply, readily

CHEMICAL REACTIONS OF . . .



1 Ferric salt in alkaline medium produces an effective silica absorbent



2 Phosphate pulls water's residual calcium hardness out of the solution

► As boiler operating pressure increases, boiler water-treatment problems increase with it. You find the tolerable limits for chemical concentrations narrowing and lowering at the same time. In fact, relatively high operating pressures require so fine a quality feedwater you can't rely on an elementary external softener alone to give it to you. Various combinations of compatible parent schemes, though, can usually provide a makeup water of the desired characteristics. Chief among these are the lime-soda and zeolite combinations and the hot lime-soda and phosphate treatments.

Lime Soda, Zeolite. Coupling lime soda with zeolite opens up a wide field of external conditioning for higher-than-normal boiler operating pressures. Just how much of each and how you should combine them depends, in every case, on the raw water's natural composition and the chemical changes it will experience.

You can take out most of a raw water's hardness in the first stage with lime and soda ash. But to push for the maximum softening at this point is not generally warranted. The valid objection made against high boiler-water alkalinities resulting from zeolite-softened makeup holds even more for water leaving a preliminary lime-soda process because its alkalinities run so much stronger. Almost always acid treatment serves as an intermediate step. Major reason for its inclusion is the inability to safely avoid foaming and carryover with such high feedwater alkalinities building up in the boiler cycle.

With combined lime-soda and zeolite softening, acid treatment performs yet another service. It protects the normal nonsiliceous zeolite bed from gradual deterioration at the lime-soda's elevated pH.

You should, though, hold acid treatment to a relatively minor role and there are some simple steps you can apply readily. Soda ash, for example, not only raises a water's alkalinity to where acid correction's, necessary, but it introduces more sodium. This greater supply of sodium in water leaving the first stage diminishes the effectiveness of the second-stage zeolite softening, Fig. 3. By limiting soda ash to a bare minimum or eliminating it entirely, where possible, you (1) improve zeolite efficiency (2) reduce required acid feed (3) save on costly soda ash.

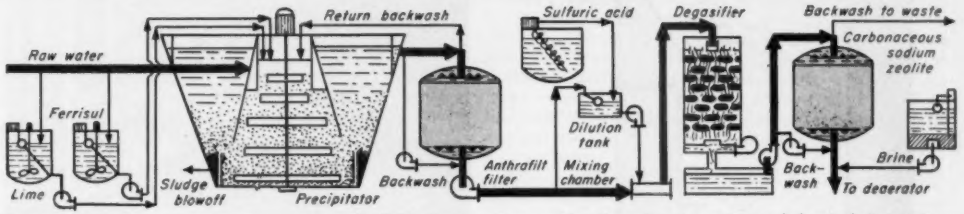
How do you get around the part soda ash plays? You let the lime do only a partial-softening job in the first stage and put the rest of the load on the zeolite. The result is a greater consumption of brine in the zeolite stage because you use more of it for more frequent regeneration of the softener bed. But the three advantages pointed out above more than meet this cost.

There is still another desirable pretreatment you can put in at the first stage—clarification and silica reduction. If you go to an aluminum coagulant in the cold process (water at 50-70 F), later possible troubles at high boiler pressures make it too risky to warrant its use. Ferric sulfate, though, proves most satisfactory for both coagulation and silica reduction in the cold process, and especially so if you use lime alone. It permits holding a pH of between 9.0 and 9.5 for the treated water—a range where ferric sulfate is most efficient. This is somewhat lower, however, than you can possibly get with a combination lime-soda treatment.

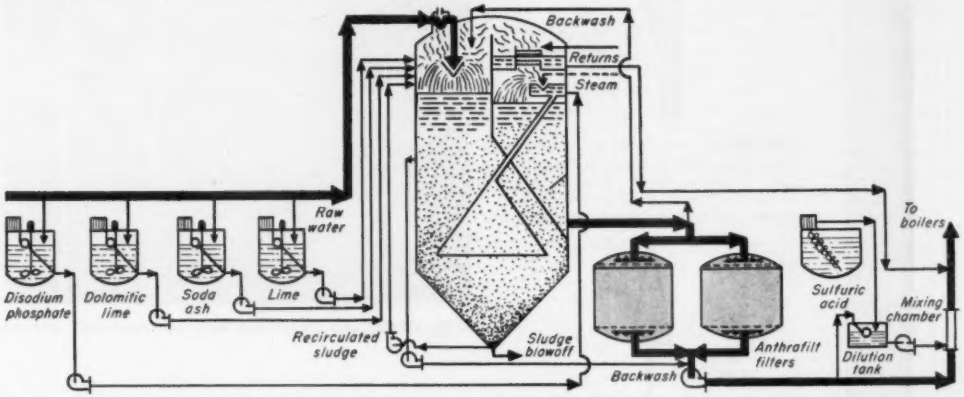
Ferric sulfate in the presence of lime precipitates a voluminous, gelatinous floc of ferric hydroxide, an effective silica absorbent, Fig. 1. It can decrease a fairly high soluble silica content to as low as 1.0 ppm. The dosage you'd use varies, of course, with the quantity of silica initially present and the extent you want it reduced. To get best results you need a thorough study. One that embraces extensive laboratory and plant trial tests before deciding on the best specific final conditions, the control procedure and the chemical feed.

Biggest drawback, and frequently the only one, to ferric sulfate is that it adds more sulfates to the makeup

. . . COMBINED METHODS, PLUS COAGULATION, SILICA REMOVAL, GIVE EXCELLENT WATER



3 Cold lime-zeolite softening opens up a wide field of external conditioning. Proportions of lime, zeolite and how they combine depend on raw water and chemical change it undergoes. Typical system with ferric sulfate helping shows above



4 Hot lime-soda and phosphate softening works best on a raw water with fairly low alkalinity at the start. Then it extracts most of the raw water's hardness, yet leaves alkalinity high enough for effective follow-up phosphate action

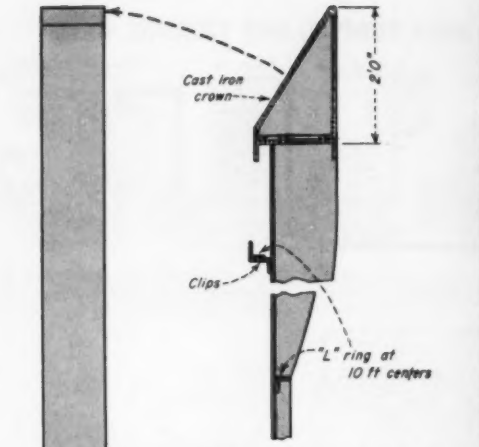
THESE VARYING COMBINATIONS CAN SUPPLY ANY NEED

	Cold lime-zeolite softening plus ferric-sulfate results						Hot lime soda, phosphate, dolomitic lime treatment				
Ppm	Raw water	Lime Ferrisul	Acid-treated	Degasi-fication	Sodium zeolite	Feed-water	Raw water	Lime soda	Phosphate effluent	Acid-treated	Feed-water
Turbidity as SiO_2	225	10	0	0	0	0	375	10	15	0	0
Total hardness as $CaCO_3$	122	52	52	52	4	2	264	20	0.5	0.5	0.3
Ca hardness as $CaCO_3$	98	44	44	44	4	2	186	18	0.5	0.5	0.3
Mg hardness as $CaCO_3$	24	8	8	8	0	0	78	2	0	0	0
P alkalinity as $CaCO_3$	0	18	0	0	0	4	0	34	22	0	2
M alkalinity as $CaCO_3$	104	40	18	18	18	14	80	50	36	18	14
Sulfates as SO_4	22	42	62	62	62	31	96	96	96	112	56
Chlorides as Cl	34	34	34	34	34	17	42	42	42	42	21
Excess phosphates as PO_4	—	—	—	—	—	—	—	—	5	5	0.3
Silica as SiO_2	17	1	1	1	1	0.5	22	0.5	0.5	0.5	0.3
CO_2 as CO_2	23	0	10	0.5	0.5	0	20	0	0	8	4
Total solids	423	167	183	173	180	92	740	263	267	278	141
pH value	7.1	9.4	7.5	8.0	8.0	8.4	6.9	10.5	10.3	8.0	8.3

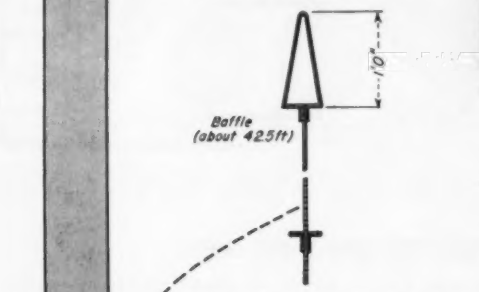
water. Below 300 psi, though, you'll find it quite satisfactory, and sometimes the same holds true up to 600 psi. But the lower dissolved solids limits put on boiler waters for high-pressure operation gives too small a leeway for any increases in saline concentrations. To ignore these limits, means an expensive rate of blowdown.

Several other iron compounds, notably hydrous ferric oxide, do not increase dissolved solids. But they are markedly inferior to ferric sulfate. Where you have to limit ferric sulfate, dolomitic lime serves as a supplement. And where temperatures run high, ferric sulfate loses its silica-absorbent

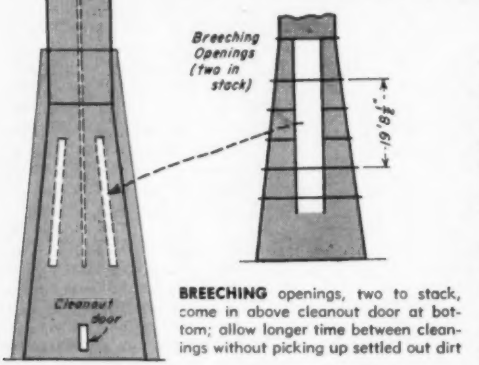
(*Continued on page 216*)



CAST-IRON crown or cap set at top of stack with vertical edge on the outside prevents flyash "coning up" on top and dropping to the ground in chunk sizes that are large, dangerous

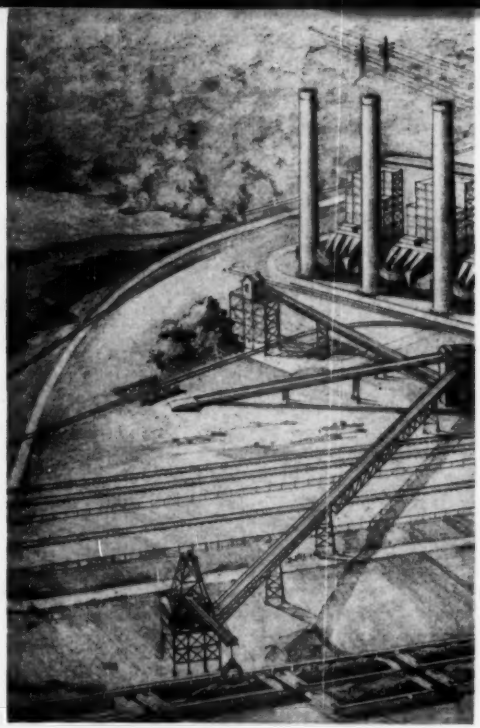


BAFFLES at base of stack, just after breeching inlet, even out flow; prevent stratification; give last chance to remove heavier entrained flyash



BREECHING openings, two to stack, come in above cleanout door at bottom; allow longer time between cleanings without picking up settled out dirt

DESIGN AND CONSTRUCTION FEATURES THAT HOLD GOOD TODAY, GIVE LEEWAY FOR FUTURE CONTROLS



STEEL STACKS like 250-ft ones here need reinforced concrete

Designing Stacks:

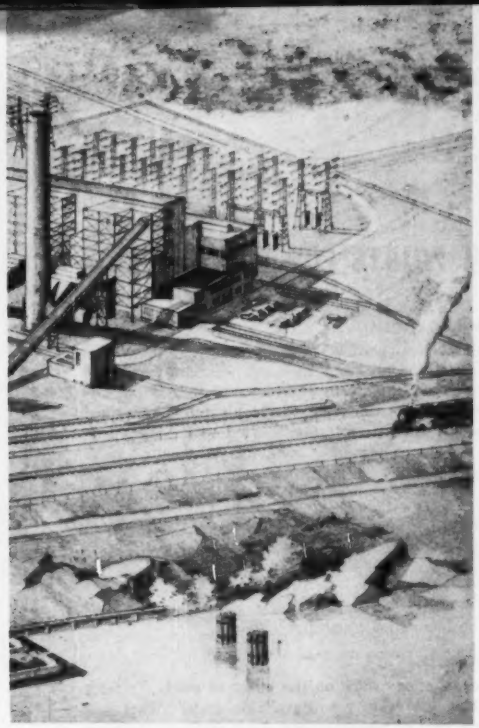
. . . Answer is yes. Use check list on page 90 to see how air-pollution control ordinances and CAA changes can upset stack calculations

► WITHIN THE PAST EIGHT to twelve years the job of putting up a smoke stack has grown from a straightforward 2-step operation to a complicated 5-step one. In the good old days you had these two things to worry about: stack design and construction. Nowadays you have to study the effect of atmosphere on stack discharge, resolve stack height to meet Civil Air Authority requirements[1], forecast the effects of future air-pollution ordinances on finished stack.

There are a number of check points, see p 90, that need answers. Many of them are the same old requirements we've always had. Others require special considerations because of these latest restrictions.

Fuel Selection. It's always smart to allow for a full range of all probable fuels economical to your area. This holds for now and into the future as well. Right along with this basic principle you should set up maximum and minimum assumptions for all calculations. These assumptions help fix the estimates of gas temperature entering and leaving

1 "How to Check Your Plant for Aircraft Hazards," POWER, Aug 1950, pp 82-85.



pads, 34 ft diameter by 9 ft thick to support their weight

Crystal-Ball Job?

By G V WILLIAMSON
Superintendent of Steam Engineering
Union Electric Co of Missouri

the stack, the boiler capability in heat demand, and the quantities of excess and infiltering air.

The breakdown below—based on 424,000-cfm flue-gas flow at maximum capacity, or 395,000 cfm for a gaseous fuel—shows the effect some typical fuel ranges have on stack design when burned with conservative excess air ratios.

	M lb gas per hr (+ 10%)	*Temp stack*	*Volume, M cfm*	*Exit vel, fps**
Normal	1344	285	409	79
Medium	1367	283	417	80
Low	1400	277	424	82
Gas	1260	257	395	75

*Stack assumed at 10.5-ft dia without further cone restriction; velocity based on stack-inlet temperature, column 3, above.

Present Practices. You can get help in answering many of the more general questions on type and number of stacks from the other fellow's experiences. Modern American practice, for example, seems to run to separate stacks for each boiler, particularly where boiler size is enough to match peak turbine capacity as is the case in recent central stations (100,000-kw turbines — 1,000,000-lb-per-hr boilers).

There's a good reason for the single stack per boiler theory in this large boiler class. Exit-gas velocities raise difficult problems throughout a single boiler's load swings without compounding them with those of a second boiler. A 2-boiler stack, for example, would have to have a four-to-one range to get by under the extreme situations of one boiler idle and the other at half load for low-load conditions and both boilers delivering at peak rated capacities for full-load operation.

There's also a definite trend, where ground area permits, to put up a "ranch-style" power plant. With the really large public utility and industrial plants, size and number of fans and dust collectors become more than roof areas can conveniently accommodate. Ranch-style design puts this equipment at ground level, increasing stack height but simplifying building steel design and auxiliary mountings.

Stack diameters, though, are a highly individual problem. You have to accurately foresee maximum gas volumes and balance construction costs against gas friction and fan power. Gas friction, of course, varies with stack diameter and flue-gas velocity. Take the gaseous fuel example in the table above with its leaving volume of 395,000 cfm and with no throat restrictions at the stack exit. Remember, 88 fps equals 60 mph. Stack friction varies as follows:

Volume, M cfm	*Internal dia stack top, ft*	*Stack friction in. wg*	*Velocity, fps*
395	12.0	0.75	63
	11.4	0.90	70
	10.9	1.18	76
	10.5	1.33	83
	10.0	1.76	91

In working out data for the case above we found that friction loss when gas velocity got above 55 fps overcame the natural-draft effect of an economical stack (somewhere around 200-250 ft). The values listed apply to a steel stack of uniform diameter above the base. Masonry stack calculations differ a little because of the taper.

Fan power costs for this sample case including energy and equipment investment run about $25,000 per inch of draft. For construction purposes a 12-ft-dia stack costs about $10,000 more than a 10-ft 6-in. dia. one. But the friction factor for the 12-ft unit is 0.58 in. wg less than the 10-ft 6-in. installation. A saving of 0.58 inches at $25,000 to the inch means $14,500 lower power costs. So a 12-ft-dia stack actually is a cheaper one to select provided only that fan power creates enough static pressure to allow for a high-velocity exit throat.

Summary below shows a representative breakdown of estimated stack-draft losses for a unit of the type we've been talking about: (Large size central station design.)

Boiler	9.9 in. wg	Inlet Loss*	0.40 in. wg
Soot hopper	0.46 " "	Stack*	0.75 " "
Gas ducts	0.40 " "	Leaving loss	0.44 " "
Dust collector	0.36 " "	30% margin	3.50 " "

*Loss in entering phase of dust collector, 12-ft dia stack assumed.

Total induced draft needed is 16.21 in. wg.

Material Selection. What help can you get for choice of stack material—steel, radial brick, tile, concrete? Right off the bat, the decision boils down to a balance between first cost and lifetime maintenance, plus carrying charges.

First cost, interestingly enough, whether steel or brick comes remarkably close to $100,000 for stack and foundations. Hollow tile with a concrete filling tends to cost more.

For more on Designing Stacks, turn page

Straight, reinforced concrete depends more than the others for its final costs on how closely you set up and follow design and construction details. Some feel you can build a lifelong concrete stack. Others doubt it.

There are cost details that miss the eye. For example, wind loading. Masonry stacks normally tapering from top to bottom offer a greater area for wind resistance so wind effect on foundation design is of great concern.

Suppose you plan to support your stack on piling. Then the greater weight of masonry may be a large factor. If you want to avoid uplift of piling, a steel stack probably needs an extra concrete base. This consideration can prove a "tricky" one in trying to allow for future addition to stack heights, brought about by new mandatory restrictions (air pollution, CAA, or otherwise).

Our experience indicates that the less foundation needed for ground-mounted steel stacks, the greater the savings (as much as 10%) on the cost of the whole stack. If you taper a steel stack to its full height for appearance sake, say, its costs go up as much as 10%.

Low chrome - copper - alloy steels, highly resistant to corrosion, may result in a lower stack cost if the designer will accept thinner plates on their greater strength. If you'll take no plate less than 5/16 in., then alloy steels may add 5% to stack costs. They may, though, more than pay for themselves in a corrosive atmosphere.

Maintenance costs are difficult to determine and, even more so, maintenance costs for stacks. Our experience shows masonry stacks go on, maintenance free, for the first 10-15 yr. But when they begin to go, repairs run high. A roof-top masonry stack can cost more to dismantle than to erect, for example. Inspection can also prove awkward. Steeplejacks typically distrust ladder-rung loops set in mortar. They reason after 5-10 yr life the holding power is open to doubt.

Ropes and pulleys "permanently mounted" cannot be relied on for a boatswain hoist after 2-3 yr. To scale a 15x250-ft stack by bands and scaffold for inspection purposes may cost $1000. A separately supported ladder on a steel stack, though, gives lifetime service. So for inspection purposes

(*Continued on page* 224)

CHECK POINTS FOR STACK DESIGN

FUEL CONSIDERATIONS:
What is the widest possible range of fuels, projected as far in the future as practical, that the stack will have to handle? What's the estimated maximum boiler capability? What provisions are there for adequate excess air for combustion? Any allowance for air infiltration? What will exit-gas temperatures run for all possible fuels and excess air ratios? They'll directly influence weight and volume of flue gas the stack has to handle. What about air-pollution ordinances?

BOILER NUMBER:
How many boilers shall a stack serve? One or several?

STACK POSITION:
Can you or should you put the stack on the roof? What's the effect on foundation economies?

DRAFT DECISIONS:
What do calculations show on the effect of stack diameter and height on gas velocity and available draft? What balance do you want to make between stack cost and draft-fan size? How much should you allow in fan size for possible future changes in exit velocity? Again it's air pollution.

STACK MATERIAL:
What are the latest data on costs? What do available experience data indicate on maintenance of steel vs masonry stacks? How about future additions?

STEEL SELECTION:
What alloy should you use? How thick should the steel be? What are the best general proportions? Should it be straight or tapering? Don't forget wind loading.

MASONRY PROBLEMS:
Have you checked all possible types—radial, brick, concrete, hollow tile with reinforced concrete fill? What's their effect on foundation economies? How about later additions?

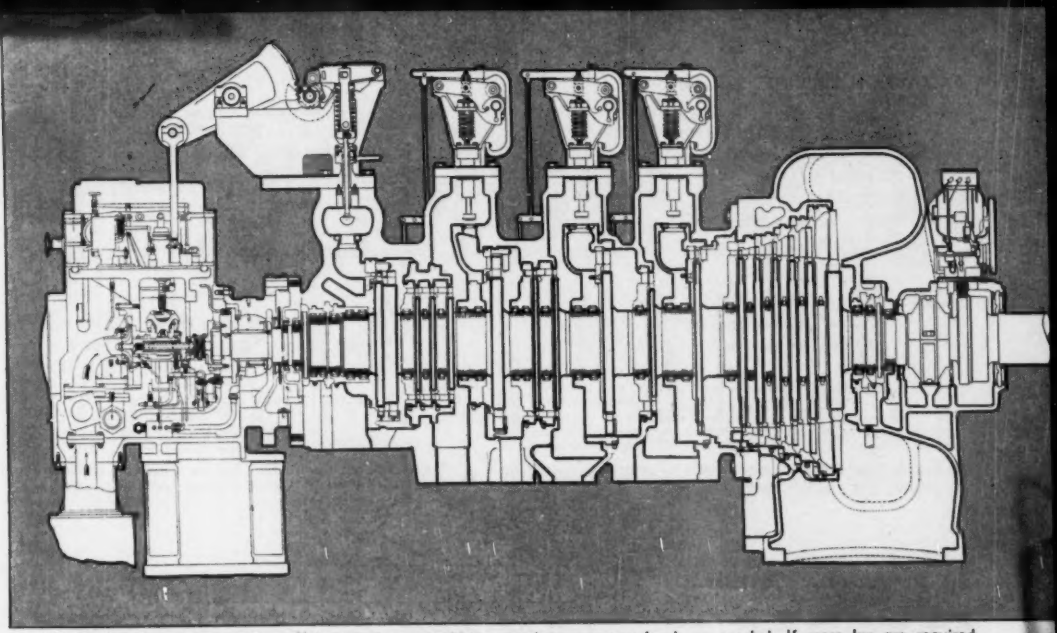
LINING THOUGHTS:
Should you use a lining? What should it be? How far should you run it? Part way, all the way?

FOUNDATION DESIGN:
Have you made provisions for future height? wind loading?

CAPPING THE STACK:
How about safeguards against lightning if you decide on a masonry stack? What about a special cap to avoid flyash collection? Make provisions for maintenance.

STACK MAINTENANCE:
Don't forget to put in clean-out provision. Add a ladder or other means for future stack inspection.

LIGHTING EQUIPMENT:
How about lighting stack top and sides for aircraft warning? Remember, you'll need to make allowances for maintenance of this lighting equipment. Don't upset stack discharge.



1 This triple-automatic-extraction condensing steam turbine takes boiler steam at throttle, supplies extraction steam at three pressure levels as needed. If more kw are required than produced by extraction flows, the steam passes to exhaust

NOW! Triple Automatic Extraction Turbines

By J M BAKER and E V POLLARD
Turbine Engineering Division, General Electric Co

Constant-pressure steam produced at three given levels shows flexibility of proven industrial-turbine application

► THE FIRST "3-arm lever mechanism" to give coordinated control of shaft speed and extracted-steam pressure was developed in 1915. In 1936, two of these mechanisms were interconnected for the control of a double-automatic-extraction turbine. Since then, over 100 of these types of turbines have been installed. Now, three of the mechanisms have been connected to control shaft speed and pressures at three extraction points. Fig. 1 shows cross section of turbine controlled by a triple-automatic-extraction control mechanism.

Applications. Many process plants have large steam flows at three pressure levels above atmosphere. The upper pressure at boiler level often supplies steam for power generation. Let's see how a triple-automatic-extraction turbine may be used in such a plant. We'll consider a typical example.

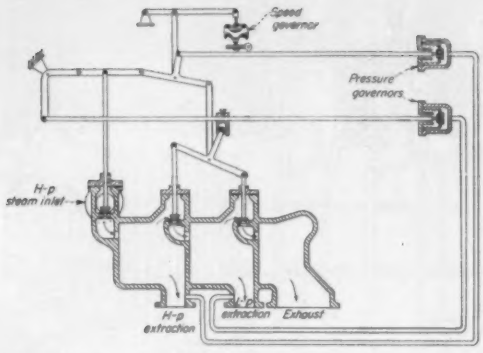
A manufacturing plant has 400-psig boilers and a condensing double-automatic-extraction turbine supplying process steam at 160 and 70 psig. Turbine throttle flow is 200,000 lb per hr, much of which is extracted at the 160- and 70-psig levels.

The 400-psig boilers are old and must soon be replaced. In addition, a plant-expansion program requires an additional 100,000 lb per hr of 160-psig steam, 130,000 lb per hr of 70-psig steam, and 15,000 to 18,000 kw of additional power.

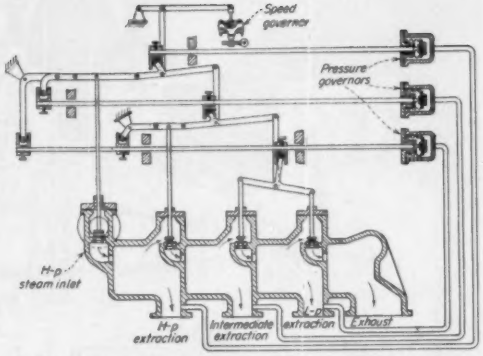
What is the best way of retiring the present 400-psig boilers and meeting the demands of the plant-expansion program? Many plans should be studied for doing this, but let's just consider two in this limited space. The alternate solutions are:

1. Install new 400-psig boilers of sufficient steaming capacity to meet the throttle-flow needs of the present condensing double-automatic-extraction turbine as well as the needs of a new turbine of the same type.
2. Install new 1200-psig 950-F boilers to furnish steam for a 1200-psig condensing triple-automatic-extraction turbine. From this new turbine, steam will be extracted at 400 psig to feed the throttle of the older turbine, and steam will be extracted at 160 and 70 psig to take care of the *increase* in the process-steam requirements caused by the expansion program.

Fig. 2 shows the performance curve



3 Double three-arm lever mechanisms automatically coordinate steam flows, shaft speed, extraction steam pressures



4 Triple-automatic-extraction turbine needs an added three-arm lever to coordinate third extraction flow and pressure

for a 15,000-kw triple-automatic-extraction turbine-generator set. This turbine has steam conditions of 1200-psig 950-F at the throttle, 2-in. Hg abs exhaust pressure, and automatic extraction at 400, 160, and 70 psig.

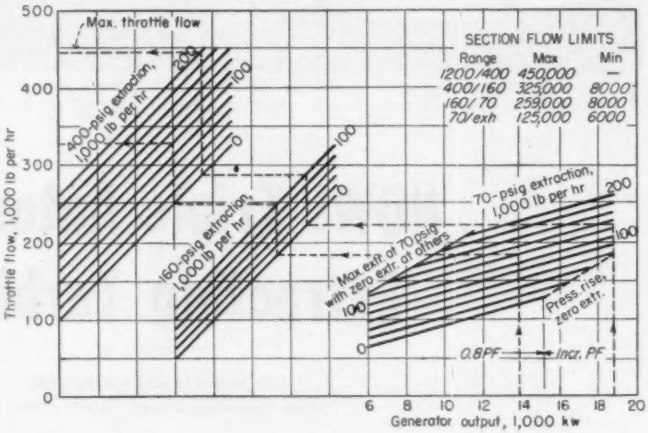
Fig. 2 helps to make an approximate evaluation of the performance difference between proposed solutions 1 and 2. To do this read Fig. 2 for the four cases shown in the table.

Case B is the one outlined as normal for the new turbine. This case shows that, with 200,000 lb per hr being extracted at 400 psig to be delivered to the throttle of the existing turbine, 100,000 lb per hr being extracted at 160 psig, and 130,000 lb per hr at 70 psig for the increased process requirements, the new turbine will deliver 18,750-kw output with only 15,000-lb-per-hr flow to condenser. This meets the increase in electrical demand.

What will be the difference in fuel consumption between the two proposed solutions? Comparison between cases A and B and cases C and D answers this.

Cases A and B have identical turbine-section flows except for the 200,000-lb-per-hr additional flow from 1200 to 400 psig for case B. This 200,000-lb-per-hr additional flow produces 5950 additional kw. Thus, by direct ratio, the 445,000-lb-per-hr flow from 1200 to 400 psig in case B must be generating 5950x 445/200 = 13,200 kw.

If 400-psig boilers are installed, this 13,200 kw will have to be generated by steam expanded from 400 psig to the condenser. Case D has the same section flows as C except that D has an additional 100,000 lb per hr flowing from 400 psig to the condenser. This 100,000 lb per hr flow generates 11,750 kw. Again, by direct ratio, 112,000-lb-per-hr


Max. throttle flow
SECTION FLOW LIMITS
Range Max Min
1200/400 450,000 —
400/160 325,000 8000
160/70 259,000 8000
70/exh 125,000 6000
400-psig extraction, 1,000 lb per hr
160-psig extraction, 1,000 lb per hr
70-psig extraction, 1,000 lb per hr
Max extr at 70 psig with zero extr at others
Press rise, zero extr.
0.8 PF
Incr. PF
Throttle flow, 1,000 lb per hr
Generator output, 1,000 kw

2 Performance curve for 15,000-kw triple-automatic-extraction condensing turbine. Steam in, 1200 psig 950 F; exhaust at 2 in. Hg, extract at 400, 160, 70 psig

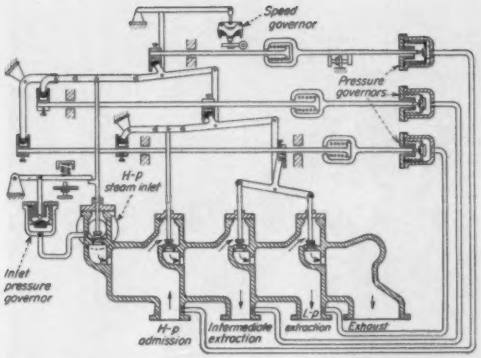
flow from 400 psig to condenser will be required to generate 13,200 kw. This indicates that if 400 psig boilers are purchased they should be designed for about 557,000-lb-per-hr flow (445,000 + 112,000).

It takes approximately 8% more heat to generate a pound of 1250-psig 950-F steam than a pound of 400-psig 750-F steam. Combining this fact with the 20% lower flow for the 1200-psig turbine, the h-p installation will need about 14% less fuel than the 400-psig setup. This 14% fuel saving may easily justify the increased cost of a 1200-psig boiler, turbine, feed pump, piping, etc.

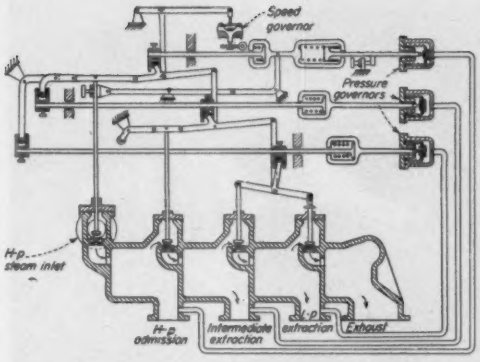
Triple-automatic-extraction turbines have a definite place in industrial plants, especially where existing steam generators are wearing out while their associated prime movers remain serviceable.

Control Flexibility. Governing of triple-automatic admission-extraction turbines can be as flexible as operating conditions require, and keep very close control of speed, pressure and other variables. L E Newman and L B Wales in their book, *Modern Turbines*, have described double-automatic-extraction turbines in which speed and two process-steam pressures may be controlled simultaneously. Fig. 3 shows a schematic diagram of this type of control.

Fig. 3 shows the interconnection between speed governor and extraction-pressure governors. Controlled variables are speed, h-p and l-p extraction pres-



5 Control diagram for triple-automatic admission-extraction unit, waste control at inlet, admission at h-p control stage



6 Control arrangement for triple-automatic admission-extraction unit with admission at h-p control stage or opening

COMPARATIVE STEAM FLOWS AND KW OUTPUT FROM FIG. 2

For Evaluating Alternate Plant-Expansion Schemes

Case	A	B	C	D
Extraction steam flow, lb per hr:				
400 psig	0	200,000	100,000	0
160 psig	100,000	100,000	100,000	100,000
70 psig	130,000	130,000	0	0
Turbine section flows, lb per hr:				
1200 to 400 psig	245,000	445,000	215,000	215,000
400 to 160 psig	245,000	245,000	115,000	215,000
160 to 70 psig	145,000	145,000	15,000	115,000
70 psig to exhaust	15,000	15,000	15,000	115,000
Generator output, kw	12,800	18,750	7,000	18,750
Increase in generator output, kw	5,950		11,750	

sures. Uncontrolled variables are throttle flow and exhaust flow. These latter are unlimited within the confines of turbine capacity to maintain constant kw and satisfy h-p and l-p extraction-steam process demands imposed on the unit.

Note that there is a minimum of two uncontrolled variables. Other turbines are in service where the uncontrolled variables are: throttle flow and kw; h-p extraction flow and kw; l-p extraction flow and kw; h-p admission flow and exhaust flow. Frequently several of these arrangements are designed into the control mechanism of one turbine for optional use by the power-plant engineer. With these he may change from one to the other from day to day, season to season, or with changes in the process of the manufactured product.

Fig. 4 shows the schematic control diagram for a triple-automatic-extraction turbine, which does not differ greatly from Fig. 3. Again, there must be two uncontrolled variables—in this case, throttle flow and exhaust flow. Increased steam demand in a process line reflects at the turbine as a pressure drop at the pressure governor controlling the stage pressure. The pressure governor opens valves in all preceding control stages and closes them in all succeeding control stages. The combined amount of steam-flow change is enough to satisfy increased steam demand and keep pressure constant in the process lines.

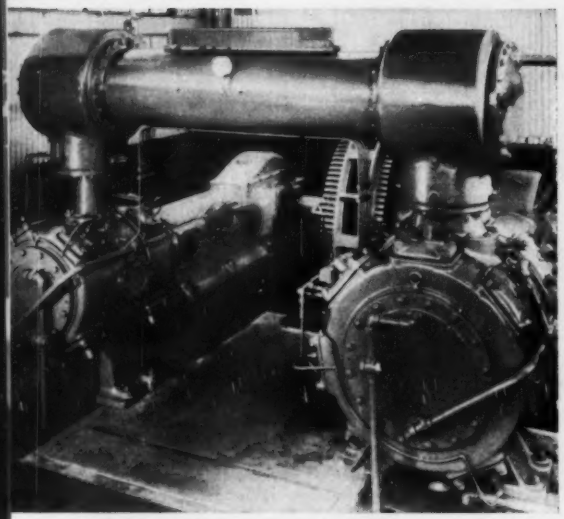
Action occurs at essentially constant flow kw output since the relative valve movement increases kw output of the preceding sections to balance the loss of output in the succeeding sections of the turbine. Time lag between increased steam demand and the change in supply to process lines is insignificant in the vast majority of cases. Actual pressure change is no more than the steady-state regulation of the pressure governor. Steady-state regulation of the pressure governor is usually set for about 2% of the absolute pressure to be controlled for an extraction flow change from zero to maximum extraction flow specified. This value may be increased or decreased slightly to meet requirements of particular plant conditions.

Changes in speed or kw load make the speed governor move all valves in the same direction an amount equivalent to the speed or kw change. This leaves the differential steam flow between one controlled stage and the other controlled stages undisturbed, thereby maintaining essentially constant extraction-stage pressure.

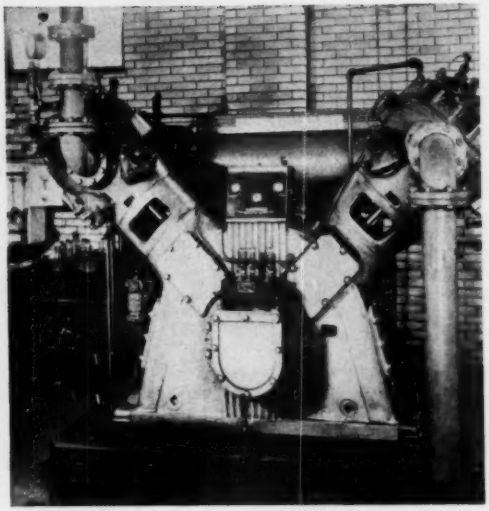
Two other arrangements of triple-automatic admission-extraction turbines are shown in Fig. 5 and 6. These are typical of many that could be used to advantage in over-all power-plant balance of steam process versus kw load.

Waste-Heat Energy. Arrangement of Fig. 5 would be used where h-p waste heat boilers worked with l-p boilers to maintain constant kw output, even though waste head output varied greatly. Outlet steam pressure of the waste-heat is usually controlled by an inlet pressure governor that limits steam flow to maintain turbine inlet pressure. Sometimes the waste-heat boiler may be

(*Continued on page 222*)



DUPLEX 2-STAGE direct-connected compressors like this unit are made in sizes up to 3000 hp. Intercooler above cylinders



VERTICAL ANGLE compressor has small foundation, takes less floor space than horizontal units. Motor-drive, direct or belt

Slash Compressed-Air $$: Pick Right Compressor

Should your new air compressor be water- or air-cooled? Single- or 2-stage? What's best control? Use six easy steps to cut air costs

By **W H WHEELER**, *Manager, Vertical Compressor Div, Worthington Pump and Machinery Corporation*

► DON'T BE FOOLED by compressed-air power costs. Reciprocating compressors (25 hp or more) may have yearly power costs equal to compressor purchase price. So if you can select an efficient compressor that cuts power bill by 10%, in ten years you've saved compressor cost. That's why efficiency is so important in compressing air at lowest cost.

What Gives Efficiency? In general, efficient compressors have (1) a good cooling system (2) right staging for working pressure and cooling system, and (3) control suited to job.

Cooling Important. Compressing a gas raises its temperature, which increases gas volume. Net result is that 36% more power is needed to compress air in one stage to 100 psi without cooling than when heat is taken away as fast as it develops.

You can't easily remove this heat as quickly as it's generated. But by cooling compressor cylinders a fair portion is removed, salvaging part of the 36% extra power.

Another way of cutting this extra power is by staging with intercooling between stages. Multistaging saves power in appropriate pressure ranges, holds temperature down and reduces carbon formation on valves. But it does add somewhat to compressor cost and complication.

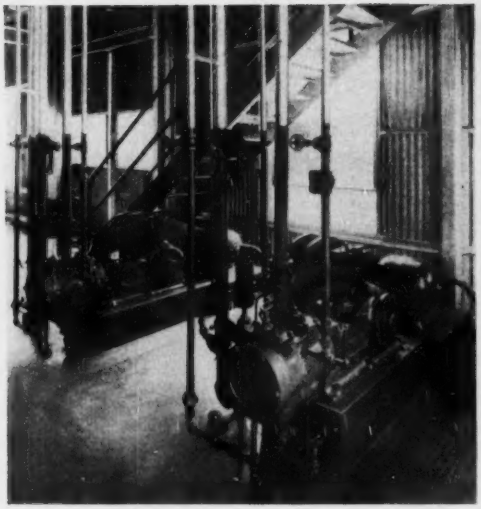
Cooling Method? Water cools better than air. Compressors cooled by water usually take less power than those cooled by air. But again, watercooling raises initial and running cost of compressor.

You can now see that staging and watercooling raise compressor efficiency. Whether they earn their keep depends on horsepower needed, annual running time, quality and availability of cooling water.

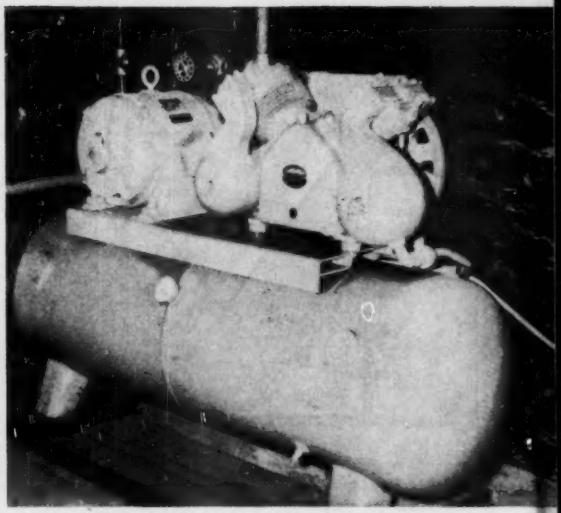
Staging. Single-stage air-cooled compressors up to 3 hp, for pressures to 150 psi, are quite common where load is light and intermittent (total of 1-hr running per day). Where compressor must run 4 to 8 hr per day to supply air, 2-stage units pay off. Table I shows it's a matter of splitting pennies. But Mr Woolworth learned that lots of pennies make dollars.

Since a 2-hp 2-stage compressor costs about $25 more than a 2-hp single-stage, it's easy to see that a heavy load justifies two stages. Not only that, a 2-stage unit runs less, lasts longer. Watercooling of single-stage unit cuts power cost, but these savings would be eaten up by water, piping and control costs.

Above 2 hp, single-stage air-cooled



TWO HORIZONTAL single-stage watercooled compressors supply air for instrument operation. These are economical, long lived



TANK-MOUNTED air-cooled 2-stage 5-hp compressor supplies air at 100 psi for a wood-working plant. See text for best use

compressors are practical and economical for pressures up to 80 psi, 10 to 15 hp. Two-stage air-cooled unit starts to pay off above 80 psi with high load factor, greater power cost and increased pressure, or any one of these three.

Single- vs Double-Acting. In range between 10 and 100 hp you'll find two general types of reciprocating compressors available for 100-psi industrial service. One is single-stage horizontal double-acting watercooled. It has been used for the last 50 years and with present refinements will run 24 hr per day for 10 or 15 years without reboring. After reboring it will be good for another run of many years.

Single-acting air-cooled 2-stage units came in about 15 years ago, cover same range as above. These are more compact, weigh and cost less, need no special foundation or cooling water. Not having the crosshead advantage of the horizontal machine they're a little on the slender side for a 24-hr-per-day job. But they're fine for 5 to 10 hr per day.

Two-stage double-acting watercooled compressors pick up where these two types leave off, with a slight overlapping. They are conventional for all sizes above 100 hp. As you'd expect, they get right down to brass-tack efficiency and are particularly suitable and economical for a substantial load factor. Table II is a comparison of

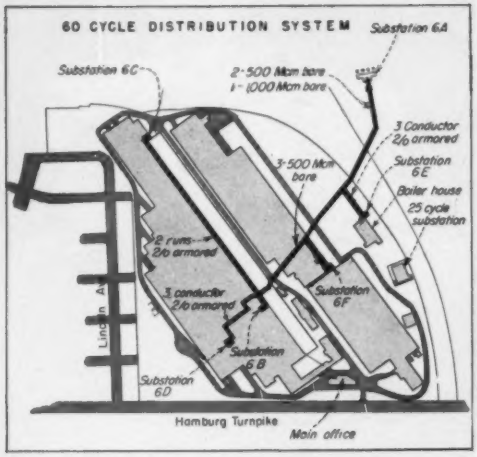
(*Continued on page 218*)

I: COMPARISON OF ONE- AND TWO-STAGE COMPRESSORS

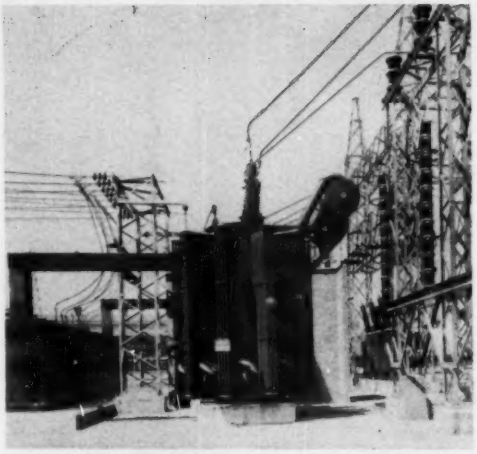
	1-stage	*2-stage*	*Savings: 2- over 1-stage*
Piston displacement, cfm	10	9	
Volumetric effic, %, at 150-psi disch	50	75	
Actual capacity, cfm	5	6.75	
Time to compress 300 cu ft, min	60	44.4	
Power cost with current at 2¢ per kwhr, motor efficiency of 75%	4¢	2.92¢	
Savings with load 300 cu ft per day			1.08¢ per day
Savings per 300-day year			$ 3.24
Savings with load 2400 cu ft per day			8.64¢ per day
Savings per 300-day year			$25.92

II: COMPARISON OF WATER- AND AIR-COOLED COMPRESSORS

100-hp motor drive	(1) *1-stage watercooled*	(2) *2-stage air-cooled*	(3) *2-stage watercooled*
Piston displacement, cfm	646	552	633
Volumetric efficiency, %, at 100-psi disch	70	78	83
Actual capacity, cfm	452	430	525
Time to compress 25,800 cu ft, min	57	60	49
Power cost with current at 1.5¢ kwhr, motor efficiency of 85%, $	1.26	1.32	1.08
Annual power cost: demand of 25,800 cu ft per day, 300 days a yr, $	378	396	324
Annual water cost at 10¢ per M gal, $	10	0	19
Total annual cost, power and water, $	388	396	343
Annual saving of (3) over (1) or (2), $	45	53	
Annual power, water cost with demand of 258,000 cu ft per day, 300 days a yr, $	3880	3960	3430
Annual saving of (3) over (1) or (2), $	450	530	
Approx initial cost; includes foundation but not electrical equipment, $	5000	4500	6500



PLANT LAYOUT and distribution of primary feeders. The power is fed from two trunk lines of the Niagara Mohawk Power Co



OUTDOOR package substation having power transformer in the foreground. Meter and battery house behind main transformer

Selecting voltage and method of distribution is first step in revamping. At Lackawanna plant, 13.8 was chosen over 6.9, overhead distribution; 60-cycle system replaced the old 25

Bethlehem Steel Proves 13.8 Kv Best

► STEPPING UP steel production to meet current needs called for a sizable increase in electric-power facilities. For the strip mill at the Lackawanna plant of Bethlehem Steel Co, it meant carrying through two electrical-expansion programs to power the equipment added.

First program called for increasing cold-mill capacity. This involved addition of a third pickle line, speed-up of two existing tandem cold reducing mills, additional coil annealing furnaces, speed-up of three skin or temper mills, revamping of two (along with installation of two new) sheet shearing lines. And as is always the case the associated equipment, both new and revamped, had to be handled along with the major equipment.

Second program blueprinted a speed-up of the existing hot mill to increase coil output to cold mill. In addition, demand called for maintaining present hot-rolled sheet output or even increasing it if necessary. Final speed-up picture in the hot mill meant installing larger motors on the No. 3 roughing stand and the No. 10 finishing stand, plus installing a No. 11 stand in the finishing train. Speed changes came into play on the stands (by gear trains) to allow a total maximum speed of 2050 fpm, compared with the former 1600 fpm.

SYSTEM FREQUENCY

To provide for the expected increase in electric power (about 25,000 kw) meant breaking away from the present 25-cycle system. This move was a must; the power company ruled any increase in plant demand above that covered by present contract (60,000 kw on a 15-min basis) would have to be at 60 cycles.

Anticipated demand for new plant was above 90,000 kw and expected maximum local generation could produce only 30,000 kw. The contract allowable of 60,000 kw was not enough. There were two choices open:

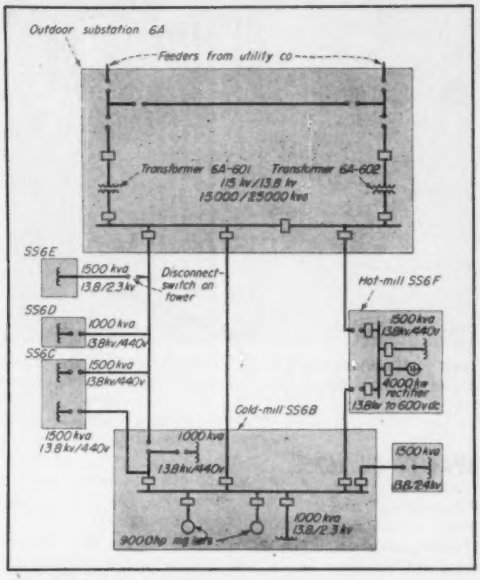
1. Purchase and install a 60-cycle substation with a 60-25 cycle frequency changer. This would mean increasing present 25-cycle primary and secondary power systems to take care of added power requirements.

2. Develop and install an entirely new 60-cycle system (both primary and secondary power) to pick up as much of the new load as possible.

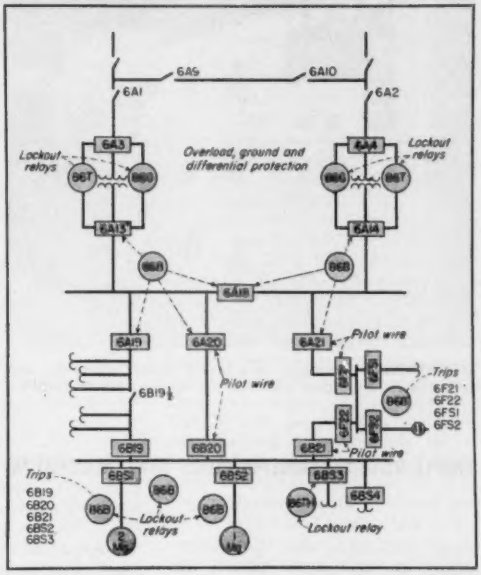
Plan 2 was selected. This plan eliminated losses in transforming from 25 to 60 cycles via the frequency changer. It also meant buying the less expensive 60-cycle motor and transformer equipment. Time has shown this to be a wise decision.

After deciding to use a new 60-cycle system, many more items opened for consideration. For instance, location of main incoming-power station had to be picked. System-distribution voltage had to be decided. Primary and secondary power-distribution systems had to be developed with thought given to type of line construction, relaying, grounding, power-line routes, substation locations, secondary power-line construction, reliability, safety, etc.

DIFFERENTIAL RELAYING PROTECTS MAIN TRANSFORMERS AND BUS SECTIONS



PRIMARY CIRCUIT layout on 60-cycle system. Bus-tie connection between both the primary feeders assures service continuity



POWER-RELAYING one-line diagram for protection of 60-cycle system. Code No. 6 before each device number keys frequency

In Plant Expansion

By R MORGAN WILSON
Industrial Engineering Div, General Electric Co
and T O ZITTEL
Electrical Dept, Bethlehem Steel Co

SYSTEM VOLTAGE

Primary distribution at 13.8 kv was selected although 6.9 kv had been used in the past for 25 cycles. The 13.8-kv system permits expansion to a much larger system than would have been possible with 6.9 kv, based on momentary short-circuit current rating of a 500,000-kva air circuit breaker. For same interrupting rating, the 13.8-kv breaker has a greater margin at its momentary rating than does the 7.2-kv breaker, which is used on a 6.9-kv volt system (see table, p 99).

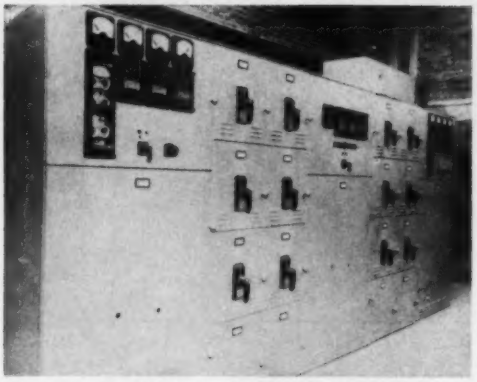
Increased momentary rating of a breaker means a great deal to the average industrial user. At the Lackawanna plant, 13.8-kv 500,000-kva breakers are used. With the 13.8-kv breaker, it is possible to have almost 15,000 kva more of induction motors on the system than would have been possible with the 6.9-kv 500,000-kva breaker. In a smaller system where the interrupting rating need be only 250,000 kva, there is even greater margin in the momentary rating of the 13.8-kv breaker. Even if it is unlikely that all the momentary rating will be utilized in practice, it is certain that some margin is desirable in all systems. Primary switchgear with 13.8-kv 500,000-kva breakers was 5 to 10% less costly than with 7.2-kv 500,000-kva breakers.

The higher voltage results in a lower value of short-circuit current—thus, less damage at point of fault. Since the ground current permitted in selecting a grounding resistor is made a percentage of the 3-phase fault current or determined by maximum size of current transformers on system, ground current can also be reduced.

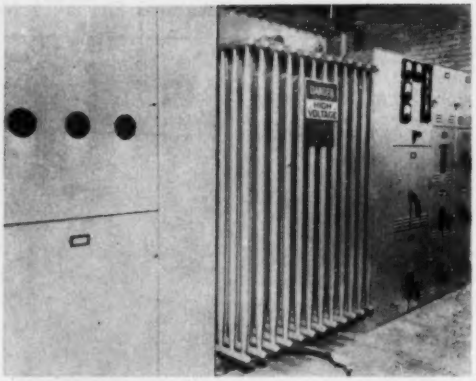
Cable cost at 6.9 kv is much greater than at 13.8 kv. On a continuous current basis it takes a cable of twice the current-carrying capacity at 6.9 kv compared with 13.8 kv to transfer the same kva. Short-circuit currents in cable can produce damaging or destructive thermal stresses and, at very high overcurrents, expulsion of combustible gases results. This can fire and damage associated electrical or mechanical units.

Conductor cross-section area must be ample to handle short-circuit current passed by breaker. This means, regardless of continuous current of circuit, there will be a minimum-size cable that can be used. For example, to handle available short-circuit current on Lackawanna system, having instantaneous tripping on feeder breakers, the recommended minimum feeder cable size was No. 2/0 Awg at 13.8 kv. But the same short-circuit kva would have needed 250 Mcm cables at 6.9 kv. Installed cost of primary cable required to meet continuous and short-circuit demand in a 6.9-kv system will be 125 to 175% of that for a 13.8-kv primary.

Motor groups, where the individual motors are rated 250 to 2000 hp, are more economically applied at 2400 v than at 480 v or 13.8 kv. Therefore, this voltage was selected to serve the No. 5 boilerhouse, the pickle line in the cold mill, and the booster pumps for hot mill. These 2400-v systems are for localized distribution as are the 480-v load-



LOW-VOLTAGE switchgear in a double-ended load-center unit substation. Note spare cubicles for handling future breakers



UNIT SUBSTATION with primary air-disconnecting switch to left of transformer. Low-voltage switchgear located at far right

TRIPLE-RATED TRANSFORMERS GIVE MAXIMUM CAPACITY OF 167%

center substations used for smaller motors. Neither system—2400 or 480—extends over the plant as does the 13.8-kv primary distribution.

GROUNDING

Neutral point of the Y-connected secondary of each main transformer is grounded through a 5.33-ohm 1500-amp resistor. Even with one transformer removed from service the second resistor will provide enough ground current on most ground faults to operate the relays. Grounding the neutral provides a return path for ground-current flow when a phase conductor grounds.

Residual relays used respond to this current and automatically and selectively disconnect the faulted circuit. Less outage time is expected since faults will be easy to locate and remove before there is a ground on a second feeder. Second fault may mean a phase-to-phase fault taking out both circuits.

Fewer insulation failures of motors and other rotating equipment are expected; grounding reduces the transient overvoltages that would occur in an ungrounded system.

CIRCUIT ARRANGEMENT

Engineers at the Lackawanna plant consulted both equipment manufacturer and utility company's engineers for assistance when needed. Final result was the 60-cycle system shown on preceding page. This shows all the substations that were installed. In addition, it is the schematic one-line diagram of the system now used.

Before going any farther, note the system of station lettering and numbering used to identify switches, circuit breakers, transformers, etc. Since the plant already had a 25-cycle system, it was necessary to develop a system of numbering that would immediately show to power-department men that equipment in question was a part of 60-cycle system.

It is customary at the Lackawanna plant to give each station a letter, in the 25-cycle system. This practice was continued in the 60-cycle system, but the letter is preceded by the number 6. Each transformer bank has been given a number, and this number is again preceded by a 6, so a transformer has a final total number that identifies it from any other and tells its location, such as 6B-607 (this is transformer bank No. 7, 60-cycle, Station B).

Each line has a number that is also applied to devices in that line. For example, air circuit breakers, on each end of line No. 20 that goes from Station A to Station B, would be 6A-20 and 6B-20, respectively. Each station air circuit breaker is identified by station letter, the letter *S*, and a number to indicate its identity. Thus an air circuit breaker in Station B supplying one of the 9000-hp mg sets is 6BS1. Single-pole disconnecting switches have a ½ following them to identify them from air circuit breakers. Hence the disconnecting switch in line 19, cycle 60, Station B, is 6B-19½.

Power supply to the system is a T-tap from each of two trunk lines of Niagara Mohawk Power Co. These trunk lines now tie the power-company system around the Buffalo area with the new utility steam plant at Dunkirk. Each tap consists of a No. 4/0 Awg, stranded, 3-phase, 115-kv, 60-cycle line. The two incoming lines from different substations will provide a high degree of source reliability. Horn-gap disconnecting switches are arranged to connect either incoming line to one or both transformers.

Group-operated disconnecting switches also allow isolation on source side of 1500-mva oil circuit breakers. Two disconnects on power-company lines let maintenance men work on all portions of the station safely. With only one switch, the entire station would have to be shut down for maintenance. This requirement meant building two incoming-station structures separate from each other.

Primary breakers when used in conjunction with transformer differential relays permit fast clearing of transformer faults. This reduces possible damage to core and coils. Their tripping can be closely coordinated with transformer secondary and feeder breakers for faults on 13.8-kv system. Fuses were considered for primary protection, but were not selected because of poor selectivity with the secondary breakers.

Greater time needed to restore service after an interruption, and possibility of single phasing, eliminated fusing. Then again, and perhaps more serious, was the probability that fuses would not melt for low values of fault current.

Such a condition might result from a secondary ground fault or a high impedance fault in transformer.

Transformers are triple-rated 15,000/18,750/25,000 kva, giving a maximum capacity of 167% of their base rating. In this kva transformer size, maximum demand on plant can be served less expensively by applying a forced air rating and accepting resulting higher losses than by purchasing transformers whose full capacity would be unused a major portion of the time. Practically full operation may be maintained upon failure of transformer or its associated gear.

Transformer secondary breakers add to selectivity and protection of system by making possible isolation of a transformer, either automatically or manually, without removing power from bus. In case of a transformer fault, secondary breaker quickly isolates unit through differential or reverse-current relaying.

Each section of main 13.8-kv bus is protected by bus differential relaying. Bus tie breaker permits service on one section while other is down for maintenance. Cold-mill substation bus forms point of transfer feed, adding to system flexibility.

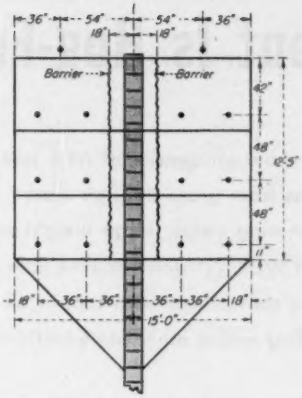
Original design used a simple high-voltage station, with only two incoming line disconnects, fuses and transformers. But there were many disadvantages, hence the scheme shown was used. Final arrangement keeps operation simple, yet gives better transformer protection and reliability.

PRIMARY EQUIPMENT

Primary substation is a completely coordinated outdoor package with a capacity of 30,000/50,000 kva, 115,000 to 13,800 v. It provides for two incoming lines and three outgoing feeder circuits. Steel structure terminates incoming line and mounts disconnects for transferring lines to transformers as needed. Lightning arresters protect substation from voltage surges over incoming lines; shielding protects from direct lightning strokes.

Transformer primary breakers are 115-kv 1500-mva interrupting rating with compressed air closing and tripping mechanisms. This rating gives adequate margin for possible future short-circuit kva available from power-company system. Structure is designed for addition of two future transformers. Present transformation section consists of two (15,000/18,750/25,000 kva) oil-insulated transformers with delta primaries and Y-secondaries with neutrals grounded through stainless-steel resistors, rated 1500 amp for 60 sec.

Incoming-power station 6A is principally an outdoor station, but has a small brick enclosure for a 250-v station battery, primary control panels, power-company metering equipment, and space for servicing circuit breakers. Main station structure is made of hot-dip galvanized steel. It was shipped completely fabricated by manufacturer and was bolted together for erection at substation location.



OVERHEAD lines have barrier between feeds. One line is worked with other hot

From incoming bushings on transformers to outgoing terminals on feeder breakers in switchgear, the substation is metal enclosed. Outdoor metalclad switchgear is protected from weather by rubber gaskets on doors and copper gauze in ventilating louvers to reduce snow blow-in.

In addition to two incoming-line breakers and three feeder breaker sections, there are two sections for lightning arresters to protect switchgear, along with a section for power-company metering transformers. Removable air circuit breakers, 13.8-kv 500-mva interrupting capacity, and drawout relays simplify inspection and maintenance of switchgear. Drawout features hit safety angle as well as easy maintenance.

LINE CONSTRUCTION

Distance between main incoming station and consuming units called for a relatively long power line. Generally in a steel plant's power-system design the station is double-fed. This installation followed that plan.

There are two principal stations, one in the hot-mill area and other in cold-mill area. They feed over a single tower line. One side can be worked safely while the lines on the other side are in operation. Line spacing is vertical with four feet between phases, vertically, and three feet between lines horizontally.

Cable Supports. Each line was 500 Mcm, bare, copper cable, except the 1000 Mcm in line No. 2. Line sizes were designed to handle some future needs. Each cable is supported from towers by 23-kv post insulators, two to a tower. Wherever strain insulators are needed to dead-end cable, three 15-kv strain insulators were used in series. In most manufacturing plants, this line would be considered greatly overinsulated for 13.8 kv. But in steel plants where dirt concentrations are high, such overinsulation is good insurance against line failure. It also cuts insulator cleaning, which is mighty important in any large steel-mill maintenance program.

LOAD CENTERS

Unit-substation construction was used for auxiliary power rather than a complicated low-voltage network system. Small (1000-1500 kva) 3-phase 1000-1500-kva transformers with either 480- or 2400-v, 3-phase, 60-cycle secondaries are fed from the 13.8-kv system through three conductor cables. Each bank has a delta primary, and a Y-secondary with the neutral solidly grounded.

(*Continued on page* 228)

COMPARISON OF 7.2- AND 13.8-KV AIR CIRCUIT BREAKERS ON BASIS OF MOMENTARY CURRENT MARGINS

Rated Kv	*A* (Kva)*	*B* (Current Ratio)*
7.2	250,000	2.44
7.2	500,000	1.67
13.8	250,000	3.34
13.8	500,000	1.90

***Note: A—Interrupting rating in kva**
B—Ratio of momentary amps to interruption amps

How Efficient Is Hog-Fuel Firing?

- **Small-boiler tests show efficiencies of 63.2 and 68.2%, with good combustion conditions from grate through stack**
- **Because of low heating value, large weight and bulk of hogged wood is handled, but system is clean, makes little smoke**
- **Cost is likely to be competitive with coal or oil if wood is used on spot, but cost of hauling makes other use questionable**

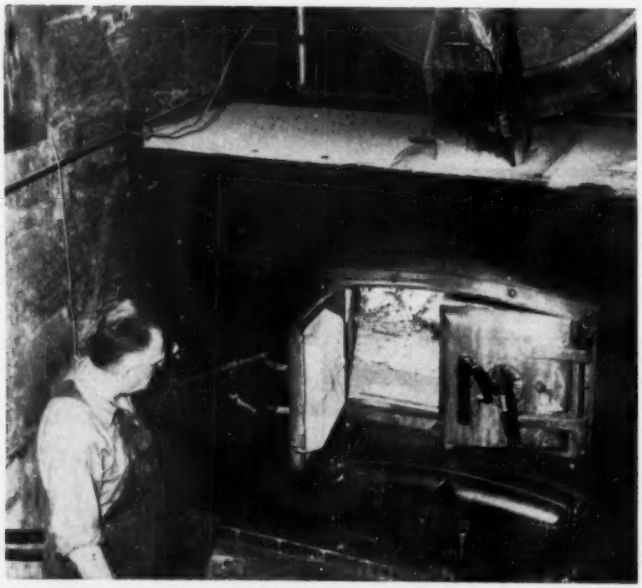
► WASTE WOOD is hogged and burned for heat and power in many plants around the country. Yet few engineers know what its efficiency in the boiler is, or how it compares with coal and oil in cost.

To answer these questions to their own satisfaction, the New England Box Co asked the Engineering Experiment Station of the University of New Hampshire to conduct boiler tests at their Concord, New Hampshire, box plant.

From the two tests made, boiler efficiencies of 63.2 and 68.2% were calculated. Burning conditions appeared good, with smoke showing from the stack only when the fuel bed was leveled. Heating value was about half that of coal and a third that of oil on a per-lb basis. Hogged fuel requires large storage space because of its bulk, but is clean to handle and use. These are the results; now let's see how they were obtained.

By L E SEELY and L E WEBBER

Engineering Experiment Station, University of New Hampshire



HRT BOILER used in hogged-wood efficiency tests. Efficiencies of 63.2, 68.2% show unit works about as well on hogged wood as the usual small hrt does on coal

The factory is heated and some power generated by burning hogged fuel (16 to 18% moisture) under a Dillon hrt boiler. This boiler, installed in 1940, has a 72-in.-diameter drum, 17 ft 6 in. long. It holds 124 steel tubes, each 16 ft long and 3 in. in diameter, and has a total heating surface of 1626 sq ft.

Test Setup. We agreed to run a test that was simple and practical, with no condensate being returned to the boiler. Feedwater makeup could be added by a steam injector. And to measure the amount added, we used an Empire 1-in., Type E water meter we found already installed in the boiler room. It could be read to 0.1 cu ft and estimated to 0.01 cu ft.

The plant hogs edgings and other waste wood down to an average of ¼ in. This is brought to a boiler-room storage bin by a conveyor and then, when needed, is air-sucked to a point above the front of the boiler. Here a cyclone separator removes transporting air and the wood drops into the furnace.

The fuel burns in a self-forming, shallow cone on the grate. Combustion air is preheated by first passing through furnace-wall ducts. All fuel used for tests was shoveled from the conveyor into a box, weighed, and dumped on the boiler-room floor. From there the wood was handled by the same air pickup normally used to feed the furnace.

In the breeching above the furnace front, we installed a draft tube, a flue-gas sampling tube, and a chromel-alumel thermocouple for measuring flue-gas temperature.

We recorded the following information: weight of fuel used, volume of water fed to boiler, flue-gas temperature and analysis, draft readings, temperature of water from both meter and injector, steam pressure (see table).

SUMMARY OF BOILER TESTS, NEW ENGLAND BOX COMPANY

Run		Draft, in H_2O	Flue-gas temp, F	Steam press., psig	Cold-water temp, F	CO_2, %		Evaporated water, lb	Fuel, lb	Boiler horsepower*	Rating, %	Eff, %
AM	Max	.70	541	122	45	8.6	AM	3500	863	117	72	63.2
	Min	.65	442	109	42	2.4						
	Ave	.68	489	116	43	5.9						
PM	Max	.75	610	116	48	15.6	PM	11,420	2600	249	153	68.2
	Min	.71	457	105	45	5.7						
	Ave	.735	557	109	47	10.1						

*Although not recommended as a measure of boiler capacity, values here are actual, developed hp, and hence have meaning.

Until laboratory moisture and heating value tests could be run, we took samples of fuel at intervals and sealed them in a can. These tests showed a moisture content of 15.7% and a heating value of 7530 Btu per lb, about half that of coal.

Two tests were run: 1 hr and 3 min in the morning, and 1 hr and 36 min in the afternoon. During the afternoon test the steam engine was generating between 80 and 100 kw of power, putting a greater load on the boiler. We noted the condition of the fire at the start of each run and tried to finish with the same kind of fire. Also, as each run finished, we brought the water level in the boiler back as near as possible to the level at which we started.

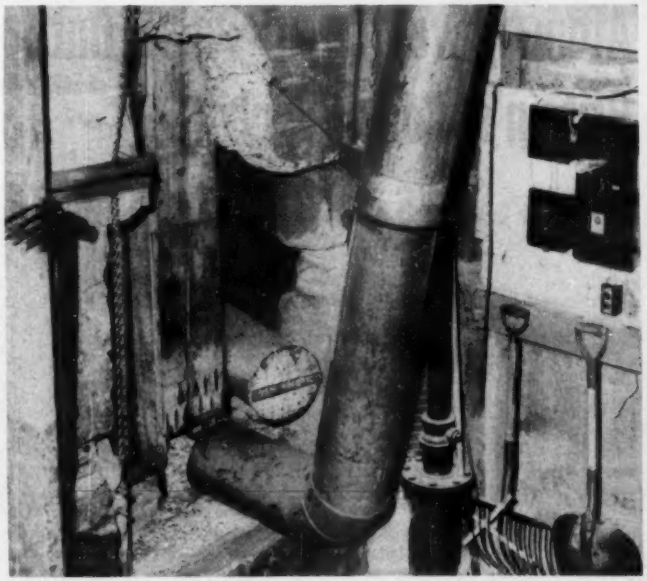
Combustion Conditions. Interpreting the results indicated good combustion conditions throughout the tests. No carbon monoxide was present in the flue gas. The only smoke we saw was caused by leveling the fuel bed, and it lasted but a short time.

Efficiencies of 63.2 and 68.2% showed that this unit works about as well on hogged wood as does the usual small hrt boiler fired on coal. Wood is generally cleaner around the boiler room than coal, although a larger weight and bulk is handled. This is due, in part, to the difference in heating value (7530 Btu per lb against about 14,000 Btu for good steam coal and 19,000 Btu for oil).

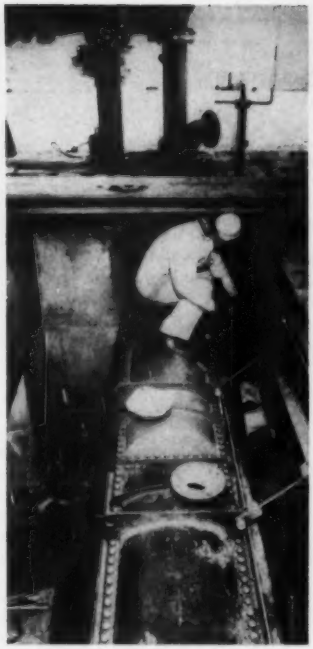
Economics of Use. Most plants that hog waste wood and fire it as a primary or secondary fuel do so on the spot. And in all but extreme cases it is the cheapest sort of fuel available, since it is a waste product involving only the cost of collection and hogging. How it compares economically with other fuels in any one case thus depends to a great extent on the cost of handling equipment—hogs, conveyors, fans, air-transport system and storage bins—compared to cost of equipment for storing and handling the usual fuels. Cost of handling can be cut down in small plants by a simplified system, sometimes requiring only a hog, bins and simple chutes.

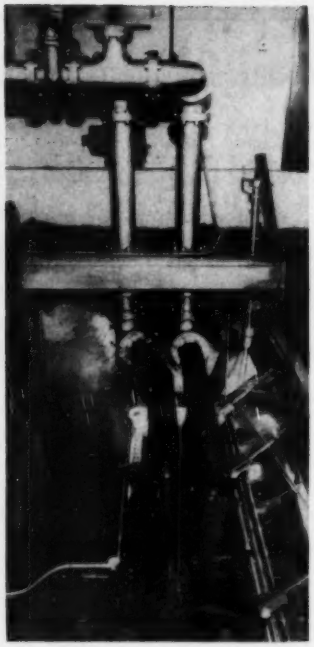
But how about hogging wood for sale in competition with other fuels? Low heating value and density of hogged fuel make it necessary to handle a much larger bulk for equal heating performance. Thus, unless other fuels are scarce and high priced, it's doubtful whether hogged wood could be hauled more than a few miles with any appreciable margin of profit.

Too, there is the added problem of storage facilities. Wood should be protected from direct rain and snow since it loses its heating value rapidly with any increase in its moisture content. And because of its bulk, it does require a large storage space. But if waste wood is hogged and used on the spot, it is a cheap and effective supplement or substitute for the rest of the fuel family.



AIR-PICKUP tube for feeding furnace: Wood is brought from hog to boiler room by conveyor, is sucked by air pickup to cyclone separator, then dropped to the grate





AT HARWELL, ENGLAND, hot radioactive air from the pile heats primary water in a heat exchanger. This, in turn, produces safe secondary hot water in another exchanger to heat buildings. See note, end of article. *Photos, British Information Service*

Atom Power Could Piece Out Britain's Coal Supply . . . . . Says Sir John Cockcroft

Condensed from Sir John's Memorial Lecture to the Manchester Literary and Philosophical Society last November

► WHEN ATOMS of uranium 235 are split in a chain reaction, each pound releases about 8,000,000 kwhr as kinetic energy ("heat") of fission products. Another 10% gradually reappears as radioactivity.

Let us see how this type of chain reaction, produced in an atomic pile (nuclear reactor), can bring to the world, and particularly to Great Britain, a new energy source to supplement over-strained and diminishing reserves of ordinary fuel. British requirements for electric power have increased 50% since 1940, and are expected to increase another 45% by 1960. This alone would require an additional 13,000,000 tons of coal by 1960. That is the practical problem.

I cannot emphasize too strongly that we do not expect atomic power to be cheaper than coal power. Instead, it will probably be somewhat more expensive. *Our real aim is to increase the total supply of power.*

Power Pile Described. A nuclear reactor will replace the usual fuel burners. The heat must then be transferred to a steam generator, making steam for a steam turbine. Or possibly to an air heater serving a gas turbine. One type of reactor is represented, in an elementary form, by the pile at Harwell, England. This pile consists of a cubical core of 800 tons of very pure graphite blocks, between which are disposed 40 tons of uranium metal in one-inch bars. The bars are sheathed in aluminum cans to prevent oxidation of the metal and escape of radioactive fission products into the surrounding space. A concrete wall, 6 ft thick, surrounds the pile to block deadly radiation.

Heat released in the uranium bars is carried away by a fast-moving stream of air. Powerful blowers deliver the air to a 200-ft stack.

Control rods containing boron adjust power level of the pile. These rods are moved horizontally into it by electric motors operated from the control room.

Some radioactivity is induced in the cooling air because natural argon in the air is partly transformed into radioactive argon. Although air coming out of the stack is slightly radioactive, the concentration at ground level is entirely safe —no more than double the natural radioactivity in air, due to radium and thorium products and cosmic rays. Also, this argon radioactivity decays very rapidly—shrinks by half every two hours (99.9% in 20 hours)—so it does not permanently contaminate the atmosphere.

We must also look out for the possible release of radioactive fission products from leaky aluminum cans. A "sniffer" will detect such leaks. As another precaution we insert high-grade filters in the exit-air passages to trap any radioactive particles.

Present normal power level of the Harwell pile is about 4000 kw (heat energy). At this power level, temperature of the surface of the fuel elements is 390 F, and exit-air temperature about 200 F. An improved type of fuel element now going in will increase surface temperature and exit-air temperature.

Pile Heats Building. We have recently installed a heat exchanger in the exit-air duct and are extracting some of the heat to warm Harwell buildings.

Remember, this reactor was not designed to deliver useful heat, which is merely an incidental byproduct. Even when we increase the power level, the heat developed is only about 200 kw per ton of uranium.

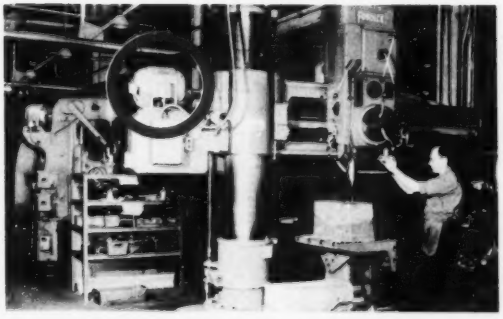
(*Continued on page* 232)

"We have three shifts in operation," says Julius J. Domonkos, Vice-President in Charge of Manufacturing, Bell Aircraft Corporation. "That's full production on a 24-hour day basis. For the past 10 years we've been depending on Tri-Clad motors to carry the load. We've never regretted putting our confidence in this fine motor!"

G-E Tri-Clad Motors drive the machines that are instrumental in producing helicopters, guided missiles, rocket motors, research aircraft, and jet aircraft engine nacelles for our rapidly expanding armed forces. At Bell Aircraft Corporation, G-E Tri-Clads are known as a thoroughly dependable motor —tough on the outside . . . on the inside . . . at the bearings.

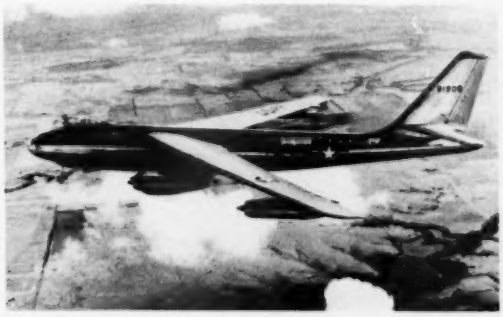
BELL AIRCRAFT CORPORATION:

"We've been depending on Tri-Clad* Motors for Ten Years . . ."



This Tri-Clad driven radial drill takes care of most of the large dies for the entire Bell plant. Big dies and bolster plates are drilled and tapped on this machine, a critical part of the Bell operation. Despite continuous use, plant personnel can't remember a single interruption due to Tri-Clad failure!

*Reg. trademark of General Electric Co.



FASTEST BOMBER IN THE WORLD! Jet engine nacelles for the 600-plus miles-per-hour B-47 are being produced at a record-breaking clip in the Bell plant at Buffalo, N. Y. The "Stratojets" represent a major advance in bombardment aircraft.

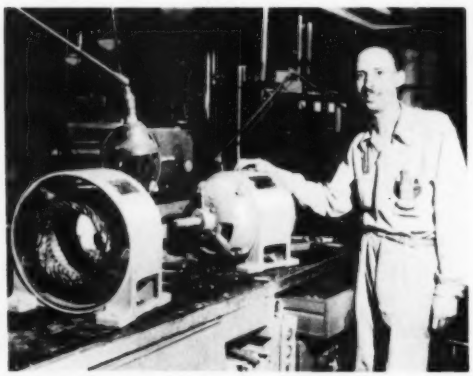
GENERAL ELECTRIC

TRI-CLAD MOTORS

REG. U.S. PAT. OFF.

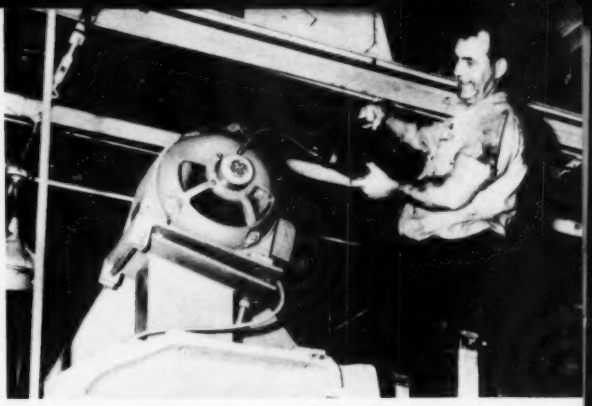
Help keep Bell Aircraft production up!

Marvin Limburg (left), Foreman of Bell's Tool and Die Shop, comments, "I don't believe we've ever lost machine time due to breakdown of Tri-Clad motors. And our jig-borers, for example *have been operating around the clock for the last 8 to 10 years!*"

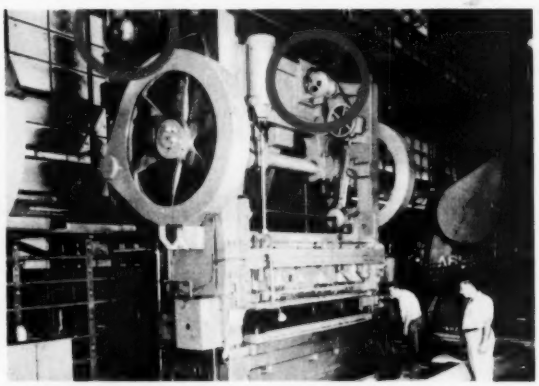


"It's the easiest motor we have to maintain" according to Maxwell Anderson, Crew Chief of Bell's motor repairmen. "There's more working room inside and more room in the slots. It's become a byword with us that if you give a Tri-Clad motor ordinary care you'll never have to worry about maintenance."

TIMELY READING—With every electric motor needed on the line, you'll want a copy of the G-E manual on "How to Maintain Motors and Generators." It's free; just ask for bulletin GET-1202. *Sect. 752-10, General Electric Company, Schenectady 5, N. Y.*



Greasing isn't necessary on a Tri-Clad motor in normal service, but it's always reassuring to know that you *can* lubricate if you so desire, without time-consuming disassembly. The photo shows how easy it is: remove relief plug, attach the grease gun nozzle, squirt—the job is finished.



This huge punch press is an important tool maker. Anton Geiser (right), assistant punch press foreman, says: "I can't recall a single shutdown of this section due to motor failure." Almost all motors in this department are Tri-Clad. This is another Bell Department which has been operating around the clock; cannot afford to lose time because of motor breakdown.

NEW! A Helpful Training Course on Motors!

Everyone concerned with technical training problems will want this new G-E Motor Selection and Application Course. Consists of 9 short, easily understood lessons. Complete kit —slide films, review booklets and instructor's manual— $100.00. Call or write your nearest G-E sales office.

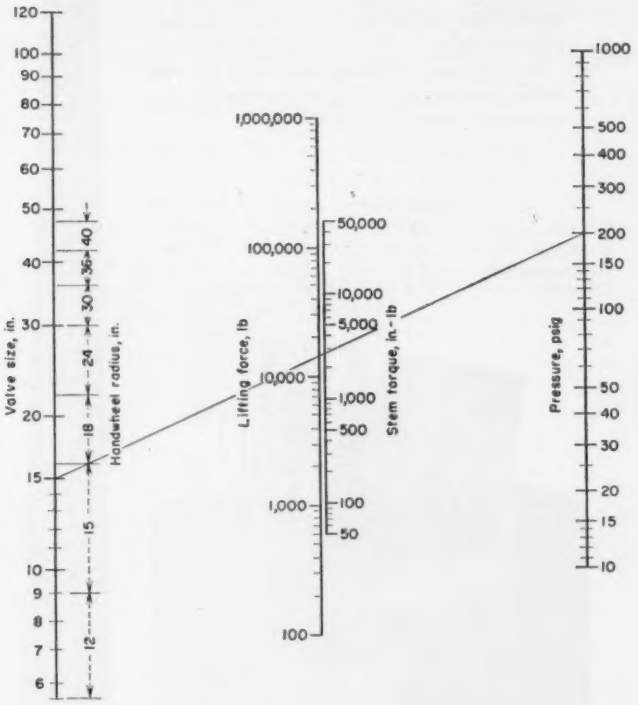
Look at the Scope of this Course

1. Fundamentals of Motors
2. Types of Motors
3. Fundamentals of Selection
4. A-C Induction Motors
5. Single-phase Motors
6. D-C Motors
7. Synchronous Motors
8. Adjustable-speed Drives
9. Gear Motors

GENERAL ELECTRIC

POWER DATA SHEET

NUMBER 236



Gate-Valve Forces and Torques

► POWER-PLANT DESIGNERS and operators must often determine the type of operating mechanism for gate valves. Usually pressure and pipe size are fixed, while disk, packing-box and screw-stem friction and disk weight have to be determined from design selected and past experience. Operating force and stem torque needed to lift the disk depend on all these variables and can be calculated correctly only if the design is known and test data are available for the friction factors. For preliminary purposes, to determine the type of operation, average experience data can be used.

Methods of valve operation generally used include:

1. Hub nut and wrench
2. Handwheel mounted on nut and threaded stem
3. Bevel or spur gearing with handwheel, screw stem and nut
4. Motor-driven gear unit with screw stem and nut
5. Hydraulic or pneumatic cylinder

The nomogram, which can be used for preliminary studies, is based on these formulas:

$$F = fd^2p_\pi/4$$

where

F = lifting force, lb
d = pipe diameter, in.
p = pipe pressure, psig
f = coefficient of friction

In the chart, $f = 0.4$. This is rather conservative for starting. It allows for packing-box friction and weight of disk.

$$T = F\,(l + f_s d_m \pi)/2\pi$$

where

T = stem torque, in.-lb
l = lead of screw thread, in.
f_s = coefficient of friction of lubricated thread, 0.2 for starting used in chart
d_m = mean diameter of screw thread, in.

Since the hand force is usually limited to 75 lb for starting, and spur or bevel gear ratios are usually 1:4, it is easy to choose the needed type of operation (with or without gearing) with the help of the chart. It can also be decided if it is desirable to include a bypass valve for filling the pipeline before opening the gate valve. This equalizes the pressure on both sides of the disk and reduces the operating force and torque needed.

Example: A 15-in. gate valve on a 200-psig water line will be remote-controlled. What torque and lifting force will the operator have to develop? Draw a straight line between left-hand valve-size scale at 15 in. and 200 psig on right-hand pressure scale. At intersection on middle scales find 14,000-lb lifting force and 2700 in.-lb stem torque. Depending on gearing used this will fix the motor or operator specifications.

H W HAMM *York, Pa.*

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BIRD PRODUCTS
Established 1795

very much pleased with

Bird & Son, one of the countries outstanding manufacturers of roofing and building materials, linoleum, shipping containers and other paper products, recently modernized their East Walpole power plant by installing a 175,000 lbs./hr. Riley single header hopper bottom pulverized coal-fired boiler unit and a 5000 K.W. generator.

Performance of the Riley boiler unit has been entirely satisfactory. Note comparison of guaranteed and actual results below.

PERFORMANCE RESULTS

	Guaranteed	*Actual*	*Plus Values*
Exit Gas Temp.	385°F.	339°F.	46°F.
Draft Loss	9.2 ins.	6.5 ins.	2.7 ins.
Air Pressure Loss	7.1 ins.	6.0 ins.	1.1 ins.
Efficiency	85.3%	86.4%	1.1%

Robert C. Holman
Plant Engineer

Mr. Holman advises he is exceedingly well pleased with the performance of the new Riley unit. We are sure he will gladly tell you of the excellent results he obtained if you care to inquire.

BIRD & SON, INC.
New Power Plant
East Walpole, Mass.

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RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
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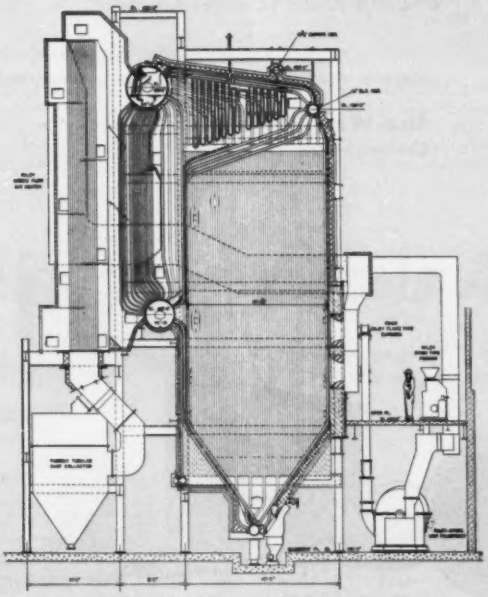
Riley Single Header Hopper Bottom Units save You money by

1. Reducing height of building required by as much as eight feet
2. Permitting installation of higher capacity unit in existing building
3. Eliminating cost of separate ash hopper
4. Eliminating cost of ash hopper seals and drip castings



BIRD & SON, INC., East Walpole, Mass.
RUST ENGINEERING CO., Engineers
175,000 lbs./hr. 710 lbs. pressure. 750°F. total Steam Temperature pulverized coal-fired single header hopper bottom Riley Units.

108 Riley Single Header Hopper Bottom Units Installed. Total Capacity 17,503,000 lbs. of steam per hour.

All of these well-known Companies have ordered Riley Single Header Hopper Bottom Units.

- United States Steel Corp.—8 units
- Esso Standard Oil Co.—5 units
- Chase Brass & Copper Co.
- South Carolina Gas & Electric Co.
- Pratt & Whitney Co.—7 units
- Western Electric Co.—3 units
- Monsanto Chemical Co.—2 units
- Norton Company
- Hanna Furnace—4 units
- Celanese Corp. of America—6 units
- Regel Textile Corp.—2 units
- American Viscose Co.
- Great Lakes Steel Corp.
- Cluett Peabody Co.
- Waldorf Paper Products—2 units
- New Orleans Public Service Co.
- U. S. Rubber Co.—3 units
- Continental Can Co.
- Utah Power and Light Co.
- Gould Paper Co.—2 units
- South Carolina Public Serv. Auth.—2 units
- Syracuse University—2 units
- Dairyland Power Co-op.—3 units
- Hooker Electro Chemical Co.—3 units
- Superior Water, Light & Power Co.
- Whippany Paperboard Co.—2 units
- Rayonier, Inc.
- U. S. Finishing Co.
- Northern Paper Mills—2 units
- Cities Service Corp.
- Calumet & Hecla Consol. Min. Co.
- Otter Tail Power Co.
- Swift & Co.
- C. H. Masland & Sons
- Upper Mich. Power & Light Co.
- Los Angeles Water & Power Dept.
- Champion International Co.
- Central Ohio Light & Power Co.—2 units

*These companies have placed repeat orders.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

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Industry looks to
Powell for the latest
in valve design
When new methods and processes create new flow control conditions, Powell is always ready with valves of correct design and materials to meet them.
That is why there are more kinds of Powell valves in service today than any other make.
The Wm. Powell Co.
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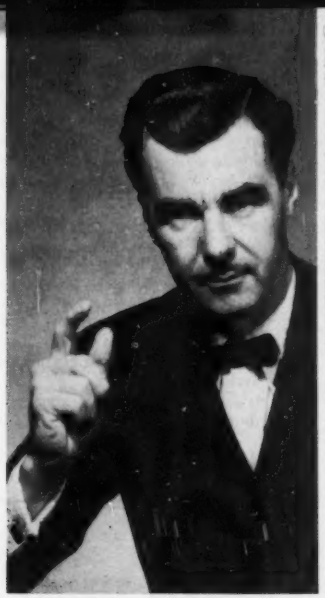
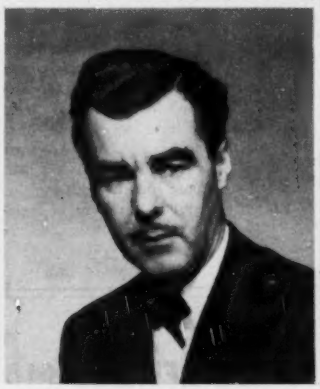
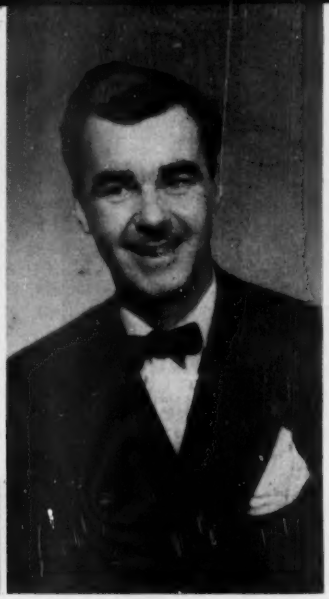
Fig. 16003 W. E. 600-pound, Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846



"OPERATING ENGINEERS . . . will do a great public service and dignify their work, too, by backing good, practical laws to make sure skilled, competent men are in all our power plants"



"PRESENT LICENSE LAWS . . . are outdated because modern equipment takes special operating skills and background. Let's streamline those old laws and start slashing accidents at once"



"DON'T OVERLOOK SUPPORT . . . of plant management, labor unions and business and engineering associations. Start by getting their backing and your job will be well along its merry way"

'Pressure Vessels Are Dynamite—License Operators,' Says L D Young

► THE OPERATING ENGINEER is now more important to our national life than ever. The community's safety and welfare depend a lot on his skill and sense of duty. Yet his job isn't well-known.

Only when heat, light or power fails does his work seem important. Or when a boiler or engine explodes and wrecks a neighborhood. That's why some cities and states have enacted "license laws." Boiler and engine operation should have a protective code. Operating engineers can do a great public service and dignify their work. How? By sponsoring practical laws to make sure that skilled, competent and responsible men are in charge of our power plants. Such laws work to everyone's benefit.

Basic purpose of engineers' laws is protecting life and property. Most such legal controls were voted into law during periods of public clamor and shock following a disastrous explosion. They have a wide variety of regulations, though they deal mostly with operating boilers, pressure vessels and engines considered hazardous.

Stationary Engineers' Laws first came in the late 1800's. Times have changed, but most of these laws have not been amended to encompass technical advancements and higher levels of skill required today. There are also many communities with no form of legal protection against negligent or incompetent operation. Correcting this situation is a challenge to those who understand danger and have a sincere interest in community welfare.

Who's Young? Manager, engineering dept of large insurance firm, Poor, Bowen, Bartlett & Kennedy, Inc, Baltimore, Md.; Chairman, Maryland Commission on Stationary Engineers Law; Member, National Board of Boiler and Pressure Vessel Inspectors; Former Member, Maryland Board of Boiler Rules; Secretary, Maryland Board of Examining Engineers.

Laws were enacted for operators long before they were passed for power-plant design and construction.

Legal codes on boiler design and power plant equipment have come in mostly within past 25 years. These are usually uniform in requirements, using ASME standards. But operating engineers' codes continue to remain neglected and confused, with few exceptions. These laws need overhauling badly. (32-p *License Requirements* compiled by POWER)

For more on Licensing Operators, turn page

HOW DO YOU PUT A LAW OVER?

Worthwhile stationary laws require the effort and cooperation of many interests. Stationary engineers can do much, but to screen and write up bills in legal form, they must enlist support of plant owners, other engineering groups, state or city legal departments, legislators, and legislative reference departments.

Consider effect law will have upon those who must conform with its requirements. But don't lose sight of basic purpose of such legal instruments—that is, to protect public and control serious hazards. (Any industrial insurance firm will tell you about such hazards.)

Properly designed, this type of legislation does benefit stationary engineers. So they must participate in the program by showing consideration of all parties subject to law's provisions. Capable stationary engineers can request certain job classifications under the law as a matter of safety.

Operating engineers must help with technical provisions of laws. First, a group of engineers should set up a committee to draw up the mechanical provisions and classifications. Study local plant operating characteristics and review accident histories.

Weigh knowledge and experience needed to operate each type and class of

GUIDE FOR NEW LAW OR FOR REVISING OLD

To write new law or revise existing act, include following classifications. Term "horsepower" is considered a workable value in specifying plant size. Manufacturers' ratings are acceptable. To classify boiler plant, use standard nominal factor of 10 sq ft of heating surface per hp.

Boilers. Explosions from negligent or unskilled operation are fairly common. Classifying boiler plants for license law is a problem. Reason is, classifying boilers by size, rating and pressures is controversial. It's generally agreed that boilers over 15-psi gage and classed as "high-pressure" units under ASME code are dangerous if improperly managed or worked.

Users of big boilers recognize value of trained, competent operators. Medium-sized plants, between 500 and 5000 nominal boiler-hp capacity, mostly use skilled operators, but not always. Small steam plants under high-pressure conditions usually have simplest job qualifications. Reason is management may not evaluate costs. Long as there is steam, their minds are at ease.

Also, automatic controls give many small-plant owners a feeling of false security. Their operator is usually safely down the street fixing the boss's car when the boiler explodes. For public safety, include a protective code for such boilers of 4 hp and over.

Low-pressure heating boilers, under 15-psi-gage steam, or 30-psi-gage hot water, are thought safe. Some feel mechanical fuel systems and automatic controls are special safety devices that prevent overfiring or loss of water. Also that they are more reliable than the human element.

But insurance records show many disastrous failures of these boilers (both cast-iron and steel) from neglect and poor operation. Single explosions have cost as much as $100,000 property damage, serious injury and death.

Heating systems in stores, apartments and commercial buildings, schools, hospitals, etc, commonly use such boilers. It's not practical to cover all such units under an operating engineers' license law, but we must arrive at some "breaking point." It's a controversial matter. Look for cooperation by real-estate associations, apartment owners, and officials in charge of public maintenance. Why not include low-pressure boiler plants of 50 connected hp (500-sq-ft boiler heating surface) capacity and over, *without* exemption for mechanical devices?

Steam engines should come under such law. Steam-engine accidents still make headlines. Engines of 150 hp and over should have licensed engineers.

Steam turbines are superseding reciprocating engines. The gas turbine is also coming along. If these machines get out of control, great destruction can result. Turbines above 150 hp require special knowledge to operate. These machines can cause extensive damage.

Diesel engines are widely used on portable industrial equipment. Such engines used as prime movers and permanently installed, of 500-hp single-unit capacity, should have licensed engineers. A smart operator can prevent crankcase explosions, broken crankshafts and other costly breakdowns.

Ammonia refrigeration plants of above 15 tons, or with compressors rated at 12 hp and over, have caused heavy damage. That goes for pressure vessels and machinery using other refrigerants.

Gas-contamination hazard is negligible in systems of 125-hp connected compressor capacity or over and using nontoxic, nonexplosive gas. They need skilled, on-duty attention.

Large-compressor plant (not refrigerant) is dangerous. This includes compressors driven by electric motors. Also those of 150 hp and over used to compress air or various gases, some explosive, for manufacturing purposes.

As these engines are often operated in battery, connected to coolers and receivers, failure may be magnified by explosion of connected pressure vessels. Include this classification in your list

Portable plants. Many license laws include portable boiler and machinery plants. Work of "hoisting and portable engineers" runs parallel to those employed in stationary plants. Portable plants are those where machinery is temporarily used in marine, building or road construction work. Operators should be qualified.

This includes operation of power machinery, derricks, pile drivers, self-propelled cranes, dredges, draglines and power shovels. Steam-operated rigs have high-pressure boilers, so classify them as above. For other prime movers, consider over-all operating characteristics.

plants. Don't penalize or deprive present operators of jobs they occupy. And don't overlook plant owners' investment or public safety. If you really want support (and you'll need it) don't forget the interests of plant owners and management.

Ask the help of state or city law departments where bill is entered. Also of local-government department responsible for codifying all legislation. In many cases, judiciary committees, representing legislators, hold public hearings to determine merit and need for a proposed law. Acceptance by such councils often insures backing and presentation of your bill to the legislature for a vote. So their support is important.

Appointment by governor or mayor of a commission to study and develop information is another method. Commission is either established directly by the government head or presented to him in form of a resolution by legislators.

In 1949, Governor P Lane, Jr of Maryland appointed such a commission to develop amendments to existing Maryland laws. This commission was sponsored by a resolution entered in the General Assembly, acting to bring existing Stationary Engineers' Laws up to date. Recommendations of such a commission, supported by administration, usually go before legislature in form of a bill.

Favorable response is stimulated by expressions of confidence and understanding of proposed law from property owners, business associations, labor unions, engineering organizations and other interests. Soliciting interest of these groups may require some concession to their particular interest in the law. *But don't make agreements and allowances at expense of workable legislation designed to prevent damages and costly accidents. For unless your new law has teeth, it won't help much.*

LICENSE CLASSIFICATIONS FOR STATIONARY ENGINEERS

Some operators of power machinery have general knowledge and experience, while others are limited in background and training to certain specified types of plants. Solution is selective examinations.

Issue license by *grade* and subdivide by *class* under each grade. Terms "any plant" and "specified plant" can further define qualifications.

"Any" covers all plant classifications under law, and "specified" applies to one or more, like refrigeration plant, steam boiler plant, etc. Shift engineer, engineer in charge, etc, are other classes.

There are such other factors as: eligibility requirements for original licenses and raises in grade, examination procedures and standards and responsibilities of certificate holders.

Include penalties for violation by person licensed, the owner, or agent of plant owner. Create or revise an examining board and set up qualifications for appointment of its members. Set up budget of this department, and provide for its support. Set amount of fees and license-renewal period. If there's a "grandfather" clause, cover present operators without penalizing them in holding their jobs. This clause deals with all engineers presently holding unlicensed jobs who would come under new law. It's best to qualify them to operate. "Shift engineer" is a licensed engineer to supervise plant operation under an engineer licensed to take charge.

CERTIFICATE CLASSIFICATIONS

First-Grade Chief Engineer. Holder to take charge or operate any plant of any hp capacity.

First-Grade Class-A Engineer. Holder to take charge or operate a specified type of plant of any hp capacity; or take charge and operate any plant up to, but not exceeding, 5000-hp capacity; or act as Shift Engineer under First-Grade Chief Engineer.

First-Grade Class-B Engineer. Holder to take charge or operate a specified-type plant up to, but not exceeding 5000-hp capacity; or take charge and operate any plant of machinery up to, but not exceeding, 1000-hp capacity; or act as Shift Engineer under holder of any higher-grade certificate.

Second-Grade Class-A Engineer. Holder to take charge or operate a specified type of plant up to, but not exceeding, 1000-hp capacity; or take charge and operate any plant up to 500-hp capacity; or act as Shift Engineer under First-Grade Class-B Engineer; or act as a Boiler Operator under holder of any higher-grade certificate.

Second-Grade Class-B Engineer. Holder to take charge or operate a specified type of plant up to, but not exceeding, 500-hp capacity; or take charge and operate any plant of machinery up to, but not exceeding, 250-hp capacity; or act as Shift Engineer under Second-Grade Class-A Engineer, or act as Boiler Operator under First-Grade Class-B Engineer.

Third-Grade Class-A Engineer. Holder to take charge or operate specified type of plant up to but not exceeding 250-hp capacity; or take charge and operate any plant up to but not exceeding 150-hp capacity; or act as a Shift Engineer under Second-Grade Class-B Engineer; or Boiler Operator under Second-Grade Class-A Engineer.

Third-Grade Class-B Engineer. Holder to take charge or operate specified type of plant up to but not exceeding 150-hp capacity; or act as Shift Engineer under Third-Grade Class-A Engineer; or act as Boiler Operator under Second-Grade Class-B Engineer.

Fourth-Grade Class-A Portable Engineer. Holder to take charge or operate any plant of portable or hoisting machinery.

Fourth-Grade Class-B Portable Engineer. Holder to take charge and operate a specified type of portable or hoisting machinery.

Boiler Operator, Class A. Holder to take charge and operate high-pressure steam stationary boilers only, up to, but not exceeding, 75-hp total connected capacity; or take charge and operate high-pressure steam or hot-water boilers of any hp capacity; or act as a Boiler Operator under Third-Grade Class-A Engineer.

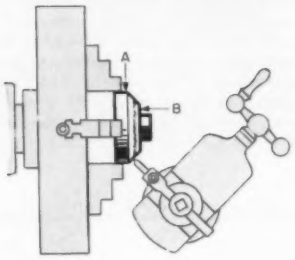
Boiler Operator, Class B. Holder to take charge and operate high-pressure steam stationary boilers only, up to but not exceeding 25-hp total connected capacity; or take charge and operate low-pressure steam or hot-water boilers of not more than 100-hp total connected capacity.

These classifications are used by some states and cities having license laws. You see from this that every type of pressure vessel is covered by licensed personnel. Standards like these insure safe operation, maximum efficiency.

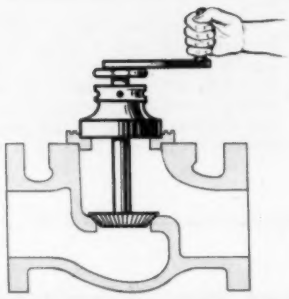
OPERATORS' NOTEBOOK 50

Repair Your Valves

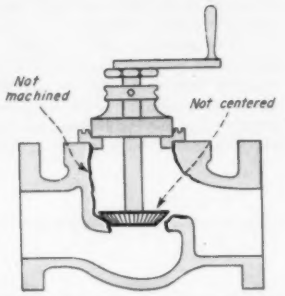
MACHINING, RESEATING and GRINDING



TAKE light cut on valve disk after truing up with a dial indicator at *A* and *B*. Set the compound rest to valve's angle

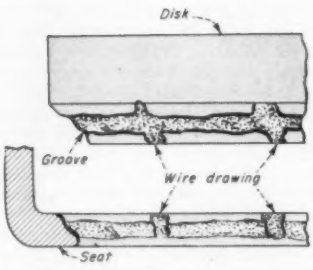


RESEAT valve body with reseating tool, or by truing in a lathe chuck. Remove only enough metal to clean up the pits

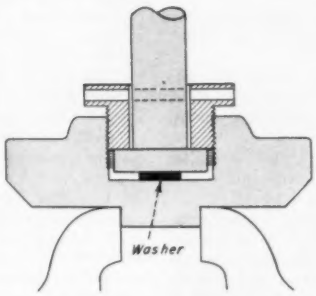


CAUTION! Do not use reseating tool if valve body has no machined finish. Only way then is to machine seat in lathe

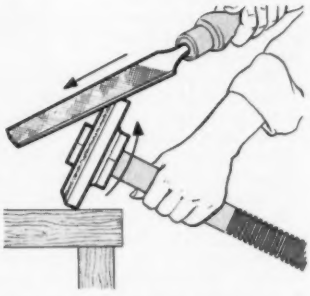
NO LATHE or RESEATER? USE HAND TOOLS



BADLY GROOVED and wire-drawn seat and disk look like this. The sealing surfaces can be restored with hand tools

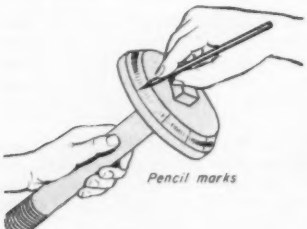


REMOVE DISK from stem and place washer or small piece of gasket under stem to lock parts solidly so disk won't turn

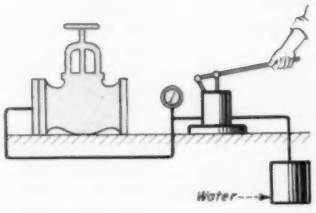


REMOVE metal on both sides of groove with file (after giving light grind to find bearing surface), keep turning disk

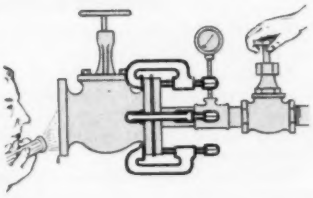
TESTING



LIGHT PENCIL-MARK the disk. Place stem in bonnet, and turn disk few degrees against seat to see that all marks rub



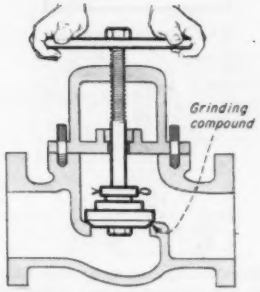
LEAK-TEST for normal work pressure with small hydraulic pump like this, after assembling valve. If not tight, grind again



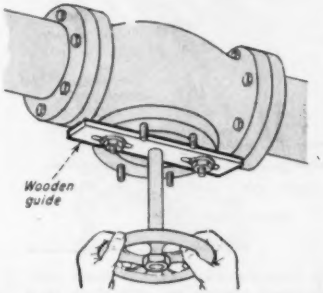
NO HYDRAULIC PUMP? Use outlet from feedwater discharge for test. C-clamps handle all size valves on the test flange

Before They Give Trouble

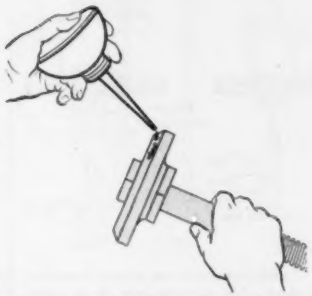
By STEVE ELONKA, *Associate Editor*



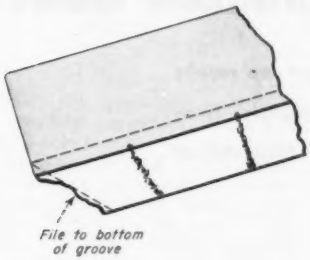
GRIND valve and disk by locking disk to shaft loosely with split pin. Use bonnet as guide. No nuts; no packing



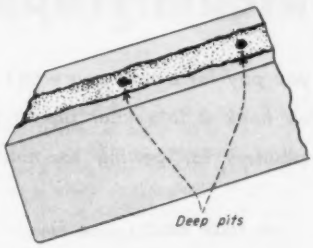
IN-PLACE grinding of large valves. Use wooden guide if upside down. Then you won't have to support the heavy bonnet



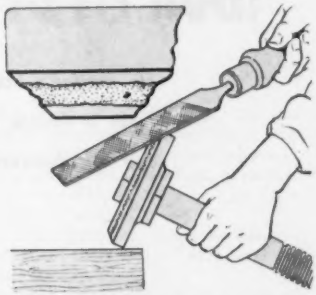
FINISH by cleaning compound from disk and valve. "Grind" with oil, clean, and again grind with oil until seat shines



GRIND with coarse compound each time you file around once. Don't touch ground surface with a file—don't file deep pits

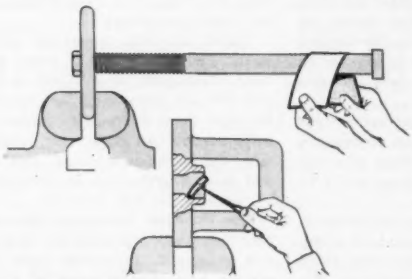


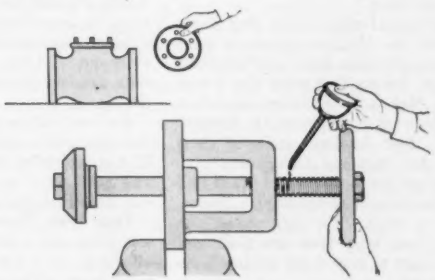
FILE EVENLY all around by turning disk so you don't file flat in disk. Idea is to remove metal that would be machined



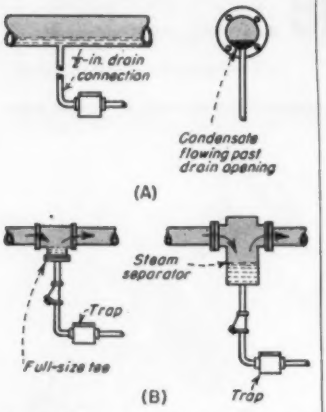
FINISH FILING carefully with fine mill file. Give grind with fine compound and grind out all pits. Then give oil rub

Don't Forget These . . .

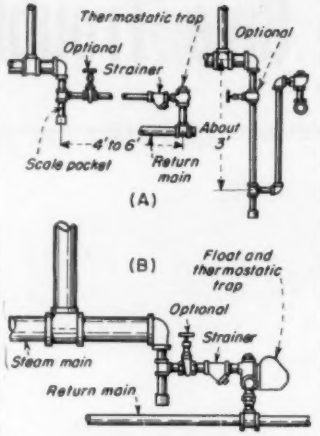




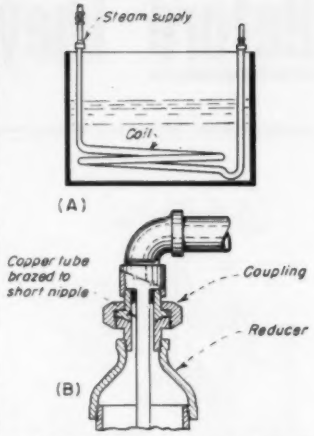
OVERHAUL bonnet assembly before finishing job. Shine up valve stem with 00 emery cloth. Replace old packing in bonnet. Replace old gasket with new. Clean threads in Stoddard's Solvent, oil. Work stem full thread length



1 Small connection *A* allows flow past inlet. Tee or separator *B* is better



2 Thermostatic trap on steam main needs cooling leg, *A*. None at *B*



3 Keep heating coil *A* drained at all times with dip pipe that's shown at *B*

Don't Put Steam Traps in the Red:

No matter what you pay for a trap you won't get top results from it unless you hook it into your piping properly. Here are six proven pointers for getting top-notch trap output

By **TYLER HICKS**, *Associate Editor*

► YOU KNOW, POWER editors really get around—to plants, conventions, meetings, and what not. We like to travel because it keeps us in touch with you men in plants. Better yet, we learn what's on your minds, what problems you have.

A couple of months back Phil Swain assigned Joe McCabe and me to make speeches on steam traps at Penn State College. Joe couldn't make it so I went alone. Men in the audience came from all kinds of institutions in Pennsylvania. And brother, some of them really had trapping problems.

That got me to thinking. I asked Phil what he thought about doing a few articles on traps. "Go right ahead," he said. "Just keep them practical, and you're sure to help many readers." So here goes!

Why Trap? You trap steam-using units for two main reasons—to take out condensate and keep unit air-free. Keep those two reasons in mind. Draining condensate is essential, but taking out air is just as important.

One man at Penn State couldn't sleep nights because his hospital laundry wasn't turning out enough ironed sheets. Patients need sheets—you can't refuse to issue them. What caused his trouble? Condensate? No. He trapped overy ounce of that. Air in his ironing rolls cut heat transfer, gave low production.

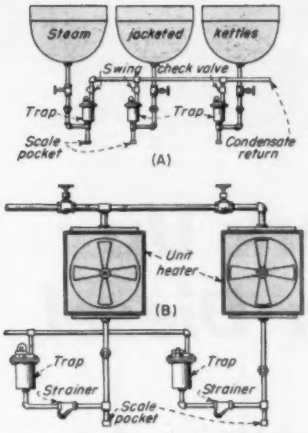
Air can cut output of some units just as much as backed-up condensate. If you remember that when you buy and hook up a steam trap, you'll be way ahead of the game.

Traps Save. If you had enough clean, soft water, you might be able to dump all drains to sewer. That way you'd save return piping and trap cost. But I doubt if there's one plant in the U.S. today that can sewer clean oil-free condensate and make it pay.

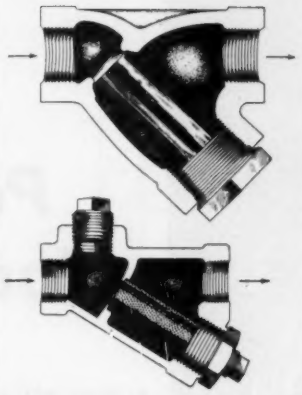
Even if a plant had enough right water, the engineer running it would have a tough time showing how he saves by dumping hot water into the drain. Water doesn't get hot by itself, you must add heat to it. Heat comes from fuel and fuel costs money. So hot water costs money.

Traps save you money in several ways. They allow you to reuse good clean condensate, stop waste of heat and vent air from units that wouldn't be much good full of air. Better yet, traps are low-cost items, easy to maintain, and have few troubles. If a trap will do a draining job in your plant, it's usually the best solution.

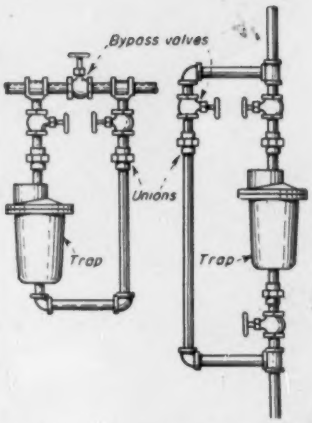
Pipe Hookups. No matter who made your trap there's a right and a wrong way to pipe it. Of course, some trap makers have special ways of piping their units. But in general you can't go wrong if you use common sense in piping. If you're ever in doubt, see trap



4 Individual traps for kettles *A* and heaters *B* give dependable drainage



5 Here are two screwed-strainer types to protect traps from scale, solids



6 Make trap repair and replacement easy; use a bypass, same connections

Hook Them Up Right and Save Heat

maker. He's always glad to help.

Trap Inlet. Suppose you have a 6-in. steam main trapped every 50 ft. If you connect a ½-in. drain line to bottom of main, Fig. 1A, most of the condensate in main flows past drain to end of main. You'll wince every time you hear the water hammer this hookup causes.

Be Generous. Use a full-size tee or a steam separator, Fig. 1B, to collect condensate before it flows to trap inlet. Then condensate has plenty of chance to collect at trap inlet. Water hammer disappears.

Above or Below? If you can, put trap below unit drained, as close to it as possible. There are times, as with thermostatic traps, Fig. 2A, when you shouldn't have trap too close to unit drained. If you don't use a cooling leg with thermostatic traps, condensate may be too hot to open trap properly.

Float-and-thermostatic traps, Fig. 2B, don't need cooling leg. For best results run steam main full size, about 6 in. beyond last takeoff before connecting trap.

Trap Above. If you must put trap above unit drained, you may use a siphon drain or dip-pipe connection, Fig. 3, as recommended by some trap makers. With it, coil won't become waterlogged and you'll always get plenty of heat from it. Arrange piping so condensate flows down into trap inlet. Or you can use a lift fitting.

Other trap makers recommend using a good check valve in trap inlet when trap is above unit drained. If there's any chance of backpressure on trap discharge being greater than steam pressure, install a check valve on trap discharge also.

Multiple Units. What about a plant that has many kettles or heaters alike? Can one trap be used to drain all these? The answer here is no.

Suppose we have three kettles connected to one trap. All kettles must be running at the same capacity at the same time to have the trap work right. If they aren't, condensate will build up in a kettle going full blast, while some steam is coming from a kettle that is just finishing its cycle. Best hookup uses a trap for each kettle, Fig. 4A, and a trap for each heater, Fig. 4B.

Strainers. Some traps have small openings in their working parts, others have levers and linkages. These parts may be plugged or damaged by pieces of pipe scale, rust, threading compound or other solids that are carried along by condensate. To you, the guy who must keep the plant on the line, that means trouble.

To get away from trouble of this kind easiest way is to use a strainer, Fig. 5, ahead of the trap. You can easily clean strainer when line is shut down. Or if line must run all the time, you can connect a blowdown to strainer bottom. With this it's easy to blow solids to waste.

Don't skimp on strainers. Use one ahead of every trap. You'll never regret it.

Make Things Easy. If your trapped line must run most of the time, install a bypass around the trap, Fig. 6. Then you can repair trap while line is in operation by closing valves ahead of and after trap, and opening bypass.

Go to uniform connections, Fig. 6, as much as possible for your traps. You'll find it a lot easier when you must do maintenance work.

Vent Air. Many traps are fitted with means to vent air from unit to which they are connected. But there are some jobs where an air vent will reduce the load on a separating trap. So play safe; if air load is large, use an auxiliary air vent. It's wise to confer with trap maker on this problem before buying an air vent.

Help Traps Do Job. You can have the best trap in the world, if there is a "best," but it's not much good to you unless you hook it up right. This article has just outlined right methods. For final say-so see maker of your traps.

PRESSURE INDICATOR shows either firing or compression pressure in the cylinder while the engine is running at any speed

Perk Up Your Diesel

By **SERGIO MARTINEZ, JR,** *Havana, Cuba*

CHECK THESE 10 POINTS

- **Combustion pressures**
- **Compression pressures**
- **Fuel-injection pressures**
- **Piston rings**
- **Cylinder liners**
- **Cooling water**
- **Bearing clearances**
- **Bearing misalignment**
- **Low bearings**
- **Injection pump**

► IN THE GOOD OLD DAYS most diesels were operated without a maintenance program. As long as the engine seemed to run OK, nobody opened it for a checkup. That kind of operation, known as "fix it when it stops," has been changed. Now, engine is checked and perked up every so many hours of operation.

Pressures. Here are two important things to check at least every 500 hours: (1) combustion pressures (2) compression pressures. These pressures are measured with pressure indicator; see photo. Every plant should have one as it pays for itself in increasing engine performance.

If maximum firing pressure is uniform in all cylinders, that should mean load is equally divided among the cylinders, also that fuel-oil injection pumps, spray nozzles, valves and piston rings are in good condition. Correct pressure for a full diesel is usually between 680 and 720 psi. If the firing pressure is higher or lower in one cylinder, inspect the fuel pump and the nozzles carefully. Also check the compression pressure of all cylinders.

Compression pressure for a semi-diesel is usually between 430 and 440 psi, and should be measured at no load. To do this, cut the fuel for an instant. During this time take the compression-pressure reading. Of course, the engine will begin to slow down, but it will pick up as soon as you open the fuel again.

A high compression pressure indicates too small piston-end clearance. Low compression pressure may mean too large piston-end clearance, defective valves or worn piston rings.

Piston Rings: Check piston rings about every 5000 hours. If ring's end clearance and side clearance are greater than manufacturer's limits, install new rings. To put piston assembly back into cylinder, a tapered guide "pot," Fig. 1, saves plenty of work, as well as the rings.

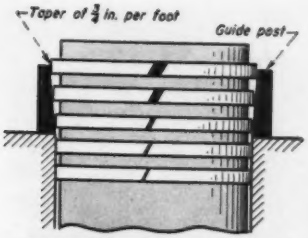
Cylinder Liners. It's good practice to check cylinder liners every 5000 hours of operation. If liners are perfectly machined and your engine is in line, the new liner should be OK. But three months after we installed new liners in one of our diesel engines, two liners were badly worn on opposite top and bottom sides. That proved costly.

This time, in replacing the two worn liners with new ones, we first checked the cylinder blocks for being level. We then checked the liners in place.

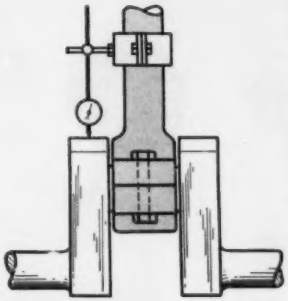
This was done by placing a square rod on the liner and hanging two weighted thin wires from it, as in Fig. 3. Weights were hung a few inches from each wall. We measured distance *O* and *P* with inside mikes on one side, and then distance *M* and *N* on the other side.

Because some diesel liners are slightly wider at the top, the difference in the bottom and top should be same on both sides. These measurements were first taken with rod parallel to crankshaft, and then checked by turning the rod 90 degrees and remeasuring.

Cooling Water. Usually jacket cooling water in a closed system is soft. Test this water at regular intervals because operators often let hard water go into system by mistake. That produces scale in the jackets. Should this happen, drain the system and flush out with a 50% solution of hydrochloric acid after adding an inhibitor to prevent

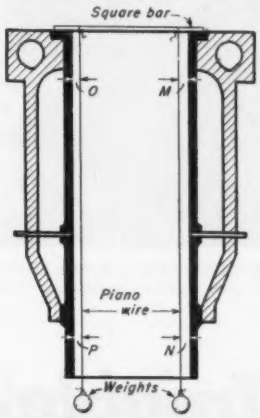


1 TAPERED GUIDE POT on the cylinder block guides piston rings, saves time

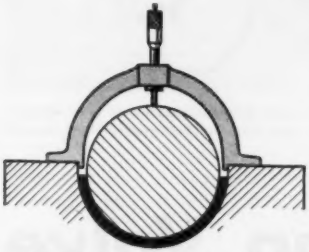


2 DIAL INDICATOR on connecting rod shows clearance of the crank bearings

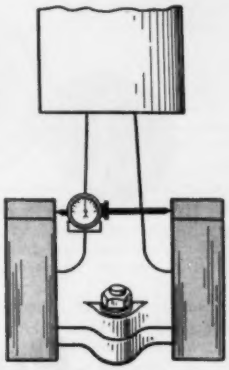
ROUTINE CHECKS AT SCHEDULED TIMES NOT ONLY PREVENT FORCED SHUTDOWNS, BUT ALSO KEEP THE ENGINE RUNNING AS IT SHOULD



3 WEIGHTED WIRES help check liner for being perfectly lined with block



4 BRIDGE GAGE shows if main bearing shell is worn, doesn't support shaft



5 DISTORTION GAGE between crank webs shows if the bearings are in line

corrosion. Wash the system completely afterwards. *Caution:* This is a dangerous operation and should be done under supervision of a competent chemist.

Bearing Clearances. Check bearing clearances after every 5000 hours of operation. One simple way to check connecting-rod bearings is shown in Fig. 2. After setting the dial to zero, place a pinch bar under the bearing's bottom half and raise the rod and piston assembly with the bar. Dial reading then shows crankpin-bearing clearance.

Every time you inspect the bearings, check the crankshaft for flexure or misalignment. Do this with a distortion dial gage, Fig. 5. Measure distances between crank webs at four positions, 90 degrees apart. Readings should not vary more than 0.002 in. If necessary, adjust the bearings to have readings within the 0.002-in. limit (see Operators' Notebook 45, Sept 1951, POWER).

Many diesel operators think because shaft is in perfect alignment, there is nothing to worry about. This is not so. A shaft may be in perfect alignment, but when put in operation under heavy load, it may be "bowed." This is because it's not supported by all its bearings.

Bridge Gage. Fig. 4 is a simple device to check shaft for this condition. First, place the gage in a horizontal position on top of engine bedplate. Set the bridge gage over the journal so the micrometer spindle is directly over the shaft's center.

Adjust the micrometer until the pin touches the shaft, then take the reading. Place a small jack on top of the crank web and force the main journal downward. Top of jack can be against a timber placed in the cylinder frame. Again adjust the micrometer so it touches the journal, then take reading. If both readings are alike, it shows that the bottom bearing is supporting the journal correctly. Check all bearings this way and make corrections if readings differ.

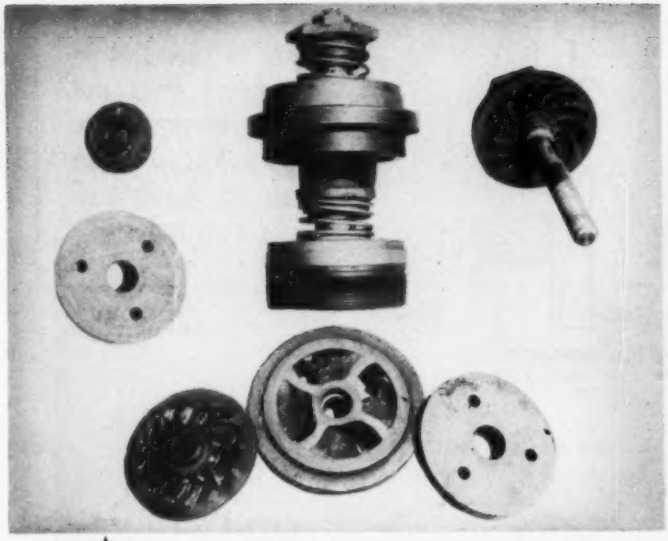
Injectors. You can repair a fuel-oil injection pump, but it's much better to have a spare one and send the defective one to a shop specializing in this work. Whenever a new pump is installed, check the timing of fuel pump carefully. Any wear in the parts will raise or lower the plunger. That changes the time plunger covers the suction and bypass ports during its upward travel. Adhere closely to timing marked on pump's Adjustment Data Plate.

Measure timing of fuel injection pump by closing the suction port. Then measure the crank angle of engine's cylinder. This is done with a bevel-protractor placed against the crank arms while checking reading within 1 crankshaft degree against value given on the Data Plate.

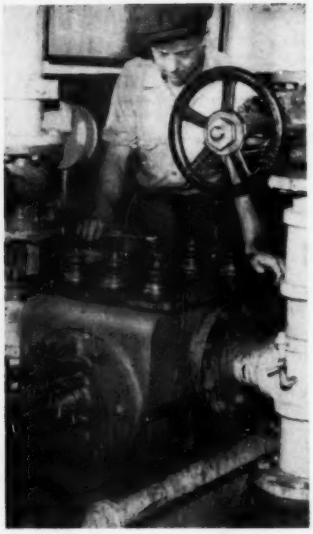
Keep Clean. One last point about diesel maintenance. Keep the engine's outside as clean as possible. No matter how good the inside of an engine is, if its outside is dirty, your boss will imagine the inside is in same condition. Then, you as the operator will be blamed for negligence if something goes wrong.

Paint the cast-iron parts and pipes neatly. Polish all copper and bronze surfaces. Have your engine sparkling outside, and know its condition inside.

And be sure to keep a log book. Show hourly temperatures and pressures. Also hours engine runs and all the repairs.



NEW ↑ Parts and assembly of new-type valve that pumped water with mixture of tar, coke braise and flyash after one year of mighty hard service

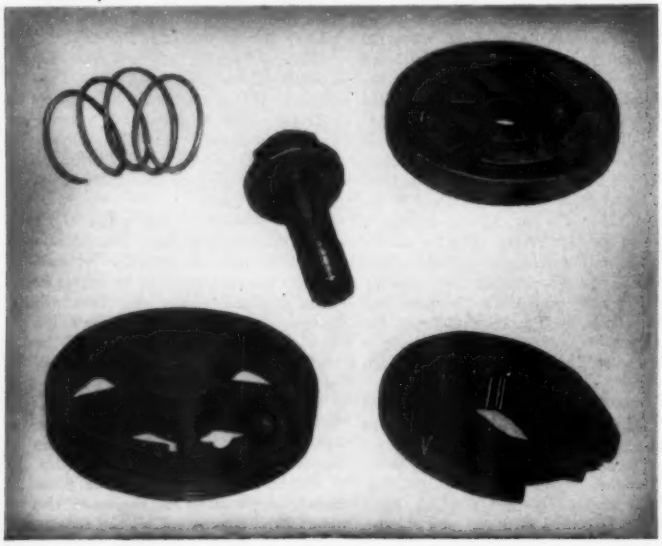


NEW VALVES in pump's valve deck are given once over before closing up pump

Pump Valve Trouble-

By GEORGE W DERUM
Sims Pump Valve Co, Inc

OLD ↓ Valve parts taken out of water pump. Soft disks are imprinted with valve seat or worn out of shape. Also, this seat is badly corroded

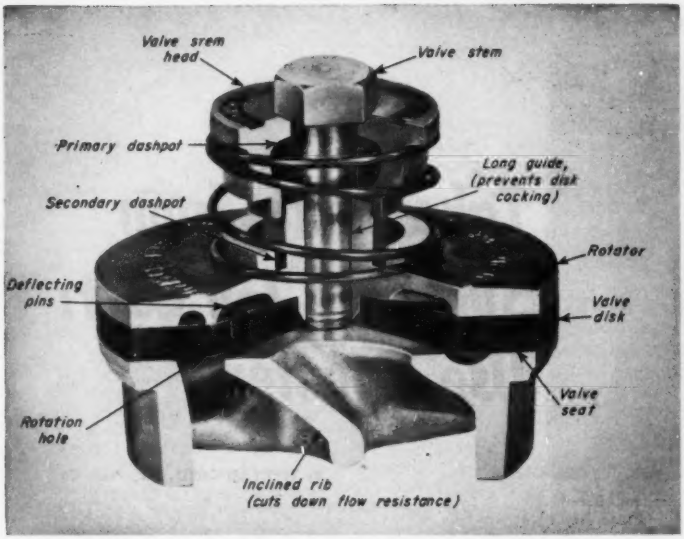


► "ONLY A FEW more years to live." That was the experts' verdict on reciprocating pumps back in 1920. But prediction turned out dead wrong. Centrifugal and rotary pumps are ahead, but there are more reciprocating pumps today than 30 years ago! One reason is that repairs are fairly easy to make.

Liquid end valves often limit pump's speed and capacity. So that's where many pump breakdowns start. Trouble is common practice of speeding up a pump so it delivers volume above rated demands. Valve wear is accelerated and soon the engineer has another repair job.

Valve knock develops, then increases as speeding piston calls for more liquid than suction valves can pass because of flow resistance. That develops a "partial vacuum" during the suction stroke. The sudden valve closing by this vacuum produces knocks, vibration in pump, surge in lines, check valve slam, and resulting damages.

Failure starts from four causes in most of the ordinary pump valves.



DASHPOTS, inclined ribs, deflecting fins and long guide against stem are designed to help this valve work silently and prevent the valve disk from cocking on stem

Shooting

Pumping sludge is easy if pump valves harness natural laws

First cause is usually worn seats or disks. Remember that in a standard-size pump, each valve in 24-hr operation at 30 rpm opens and closes about 300,000 times each week. Wonder is there isn't more trouble.

At a moderate-psi pump discharge, total force acting on a 4-in. valve is about 1200 lb. Usual result of these thousands of operating cycles is pitting, scoring and wiredrawing of valve's seating surfaces. Such valves are usually put back into service after refacing removed valve seats. Using soft disk material in trying to prevent seat wear results in disk becoming imprinted by seat. This causes leaking.

Best remedy for this trouble is a pump valve that causes its disk to turn slightly each time it opens. This is done by features like inclined ribs to guide liquid through seat, flat disk with small holes and a special rotator guard plate on top of disk—all working together to cause and control rotation.

Liquid passes through and emerges from inclined port seat at angle so disk is not thrown violently upward. Disk lifts only enough to discharge liquid according to pump speed. Valve parts are proportioned to permit all life necessary for maximum speed without fear of valve slam. Then valve breathes smoothly, rather than gasping and knocking.

Liquid, to escape, does not have to make right-angle turns that cause current confusion and flow resistance. Rotation of disk and smooth breathing action of valve help maintain a tight, leakless condition between disk and its rotator guard plate above, also seat face below. Long guide in hub of rotator guard prevents moving parts from cocking up on one side. That minimizes stem wear.

Second most common cause of failure is valve breaking. Usually stem breaks off flush with valve seat, making it tough to remove. Sometimes stem is strengthened by "spiders," "crow's-feet," and other bracing devices.

A more effective method is to build a cushioning chamber, or dashpot, into the stem head. Liquid trapped in these cushioning chambers acts as a shock absorber when valve is thrown open. Up to 50% increases in pump capacity are possible with valves combining above features of inclined ribs, rotating disks, and dashpot cushions between moving parts.

Third cause of trouble is weakened or broken springs. While cylindrical springs with parallel ground ends are commonly used, their life is not usually long unless they are protected. When coils jam together time after time, fatigue is rapid. This jamming that weakens springs can be prevented by mating parts of stem head and backing plate to meet before coils are crushed together.

Fourth cause of valve failure is corrosion. For most pumping conditions in average plant, excellent service is given by a high-grade phosphor-bronze seat, stem and rotator backing plate. Use disk of laminated phenolic resin. This combination is used in many services, like boiler feed, fuel oil, general service and fire pumps in many power plants. But take special care before selecting material for use in process pumps.

Case History. In 1942, all the foregoing "trouble makers"—disk trouble, spring trouble, stem trouble and corrosion—were causing headaches for John Burmeister, master mechanic at Citizens Works of The Brooklyn Union Gas Co.

The most severe condition was from handling tar, a byproduct of water-gas production. Equipment runs 24 hr a day in pumping a mixture of tar, coke braise and flyash in water. Temperature ranges up to 160 F at 60 psi.

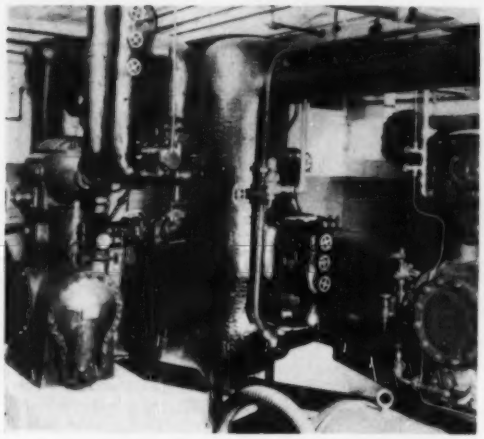
Conventional valves, he learned, had to be cleaned every 24 to 36 hr. That job took two men four hours on each pump. Besides, seat and disk wear was rapid, and springs and stems broke often. With cast-iron valves, entire set had to be renewed at least every two months.

Burmeister installed valves with inclined ribs and rotating disks. Valve manufacturer guaranteed three years' service. The valves were made of Ni-Resist because of this metal's ability to take the rugged operating conditions and corrosion present.

Since installation, the only maintenance necessary is annual inspection and cleaning. After four years, disks were replaced and a light facing cut taken on valve seat faces. Put back into service, these valves are still in operation.

This shows what happens when the valve mechanism correctly harnesses the laws of nature, also when the right metals are used in doing a tough job.

COMPLETE BOOSTER SYSTEM

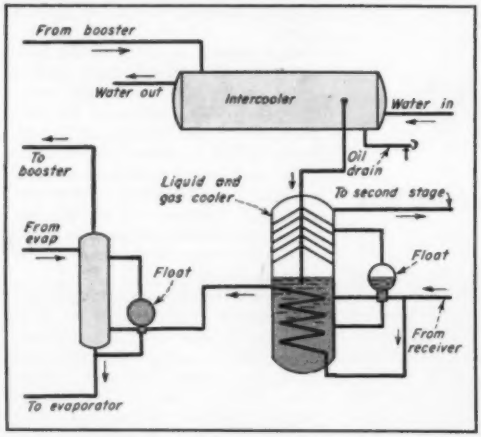


1 Low temperatures are held by this booster system. Booster *at left;* intercooler, *center;* second-stage machine, *right*

Take Sting From Sub-Zero Job Cost: Use Boosters

By TERRY MITCHELL, *ME, Frick Co*

BOOSTER FLOW DIAGRAM



2 Intercooler and liquid-and-gas cooler are important in booster systems. They take out some heat of compression

► IF YOU RUN refrigeration plants, you're almost sure to bump into one fitted with a booster system sooner or later. Quick-freezing of foods and more thorough test programs by industry have widened the need for sub-zero refrigeration.

Booster System. At 0 psig, one pound of ammonia has a volume of 18 cu ft. Pull this pressure down to 10 in. mercury, and the same pound swells to 50 cu ft. At 5 in. mercury the volume almost doubles; it's 98 cu ft. Since each pressure corresponds to a certain temperature, it's easy to see that standard compressors can't handle loads from say –80 to +80 F. Gas volume is too large.

The booster system cracks this problem for us. Better yet, it does it at low first and running costs. Here's how:

Specially designed booster compressor, Fig. 3, draws thin gas from our low-temperature coils. Suction pressure is less than atmospheric; discharge is about 30 psig. Gas leaving booster passes through watercooled and liquid-and-gas intercoolers, Fig. 2, to have superheat removed before going to the standard compressor.

Gas is compressed to condenser pressure in the standard compressor. Work of compression is thus divided into two stages with intercooling between. If coldest temperature needed is –50 F or below with ammonia, three stages of compression are used.

Refrigerant. Can you use a booster system with most any refrigerant? The answer is yes. But job results show ammonia is most suitable for holding temperatures down to –75 F. When you need –100 to –110 F, Freon-22 is better because it works with a higher suction pressure. With Freon three stages are used below –80 F.

Other refrigerants, like ethylene, are needed for very low temperatures. These are often condensed by Freon or ammonia in a "cascade" system.

You can expect to see more improvements in low-temperature plants because modern industry is finding many uses for extreme cold. One new plant freezes a million pounds of food per day.

Using Boosters. To decide if a booster system is needed for your plant load you must have some facts handy. Here are important ones worth keeping in mind.

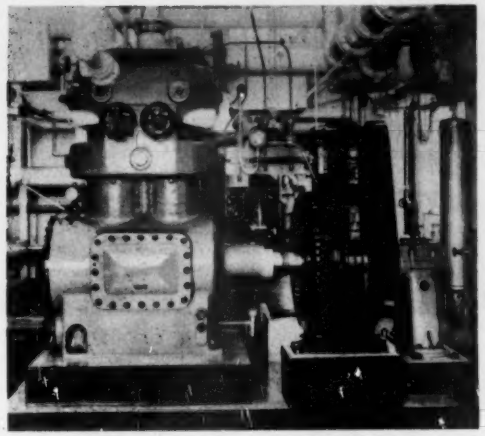
Boosters usually pay off when gas is compressed to more

I: REFRIGERANT VOLUME NEEDED FOR BOOSTER

Suct temp, F	Ammonia		Freon-22		Freon-12	
	Cu ft per ton	No. of stages	Cu ft per ton	No. of stages	Cu ft per ton	No. of stages
–100	——	—	40.4	3	——	—
– 90	——	—	29.0	3	48.4	3
– 80	31.2	3	22.5	2	37.6	2
– 70	21.7	3	16.85	2	28.2	2
– 60	15.9	3	12.76	2	21.35	2
– 50	12.51	2	9.82	2	18.20	2
– 40	9.4	2	7.76	2	13.00	2
– 30	7.2	2	6.26	2	10.30	2
– 20	5.6	2	5.04	2	8.30	2
– 10	4.4	2	5.21	1	6.69	2
– 0	3.5	2	4.19	1	6.82	1

BOOSTER COMPRESSOR

Thirty years ago refrigeration temperatures ran from 50 F to a few degrees below zero. Today some plants go down to –50 F and freeze a million lb of food. How? Booster systems turn the trick at low costs



3 15x10-in. booster is driven by a 75-hp 360-rpm motor. Neat installations like this cut low-temperature costs

than eight times its original pressure. When figuring the compression ratio be careful to use absolute pressures, not gage. As a rule, a plant carrying a suction pressure of less than 5 psig saves money with a booster.

Ice-Cream Plant. There's a single-stage compressor in this plant. Suction pressure is 12.3 psia, discharge 199.7 psia. Compression ratio is 199.7 ÷ 12.3 = 16.2, or about twice what it should be if our first rule is to hold. Ice-cream plants often have conditions like this so you'll find that boosters are widely used.

Temperatures. If you consider temperatures instead of pressures, don't forget losses or "splits." To hold a freezer at –40 F ammonia in coils should be 3 to 15 F colder. Exact temperature depends on amount of cooling surface, circulation of air and liquid, plant layout and operator's skill.

Condensing temperature is often 10 to 12 F higher than water temperature. With superheated suction gas (pressure lower than shown by temperature) and a discharge pressure higher than expected, compression ratio gets bigger. This means you may need a booster.

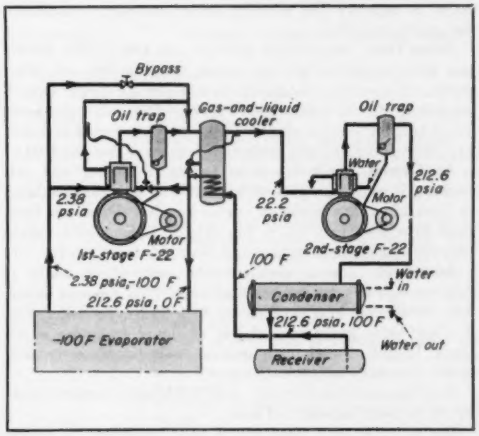
Power Needed. You may be surprised to read this, but a booster system takes less horsepower per ton of refrigeration than single-stage compression. You'll find this to be so whenever temperature is very low or condensing water warm. At 0-psig suction, a single-stage unit takes 2.8 hp per ton; with a booster it is only 2.2 hp per ton.

Boosters prevent dangerously high discharge temperatures from superheat. Lubrication of compressor is easier.

System Cost. As temperatures go down you'll save 25 to 50% on system first cost by using a booster. If your present compressors are large enough to handle booster discharge, motor for this unit need be less than half the size of that for a single-stage compressor of same capacity.

Load Balance. To balance load between booster and second-stage machine have compression ratio about equal in each. Right intermediate pressure can be found by trial. Some engineers multiply the low suction pressure by condensing pressure and take the square root of the result. This is intermediate pressure. Booster usually discharges at 20 to 40 psig, uses less power than second-stage machine, which carries the liquid precooling load. (*Continued on page* 120)

TWO-STAGE FREON SYSTEM



4 Temperatures and pressures used in this two-stage Freon-22 system show why two compressors can cut the running cost

II: LOW-TEMPERATURE FREON-12 SYSTEMS

1, 2 & 3 stages; 109.8 psia discharge pressure

Temp, F	Suct press., psia	Total comp ratio	No. of stages	Interm press.	Ratio per stage	Cu ft per min per ton
0	23.87	5.22	1		5.22	6.82
–10	19.20	6.48	2	48.9	2.55	6.69
–20	15.28	8.16	2	43.7	2.86	8.30
–30	12.02	10.35	2	38.7	3.22	10.30
–40	9.32	13.36	2	34.1	3.66	13.00
–50	7.125	17.45	2	29.8	4.18	18.2
–60	5.365	23.2	2	25.86	4.82	21.35
–70	3.971	25.05	2	22.30	5.61	28.2
–80	2.885	43.2	2	19.00	6.58	37.6
–90	2.054	60.6	3	10.10	3.5	48.4

III: TWO-STAGE REFRIGERATING SYSTEMS

–40 F Saturated Evaporator Temperature

	Ammonia	Freon-12	Freon-22
Evaporator press., psia	10.41	9.32	15.31
Booster suction temp, F	–30	–30	–30
Suction-gas superheat, F	10	10	10
Intermediate press., psia	45.7	34	55.4
Intermediate saturation temp, F	18	18	17.5
Suct temp, main compressor, F	28	28	27.5
Main compressor suction supht, F	10	10	10
Condenser press., psia	200	124.5	200
Condenser sat. temp, F	96	96	96
Gross cfm per ton, 1st stage	15.23	20.85	11.7
Bhp per ton, 1st stage	1.41	1.38	1.31
Temp, liquid to exp valve, F	40	40	40
Cfm per ton, 2nd stage	3.39	6.4	3.94
Bhp per ton, 2nd stage	1.34	1.54	1.6
Vol eff, 1st stage, %	65	67.5	72
Vol eff, 2nd stage, %	80	73	75

Select Size. Pick second-stage machine so it has 12 to 15% more capacity than first-stage. You can direct-couple a 2-cyl 15x10-in. booster to a 2-cyl 9x9-in. second-stage machine with a 175-hp 360-rpm synchronous motor between.

Use capacity-control valves on booster to balance load as suction pressures vary. Open control valve on one cylinder to halve its capacity. Use slipring motors on separate machines for speed control.

Other Jobs. Second-stage machine can also handle suction gas from ice tanks, storage rooms, milk coolers and other medium-temperature loads. If these loads are large, second-stage machine must have more capacity. Oldtimers who spent years keeping suction pressure high never got used to boosters. They said they "just robbed the suction of that much gas."

Be Careful. Don't figure on buying a booster and just hooking it into your present system. You can run machines in parallel with a common condenser. But when you hook them in series, Fig. 1 and 4, you need an intercooler between. Otherwise, gas may overheat and plant use more power.

Intercooler. Use a shell-and-tube unit where water is cold enough to cool booster discharge. This removes superheat; remaining heat is taken out by a flash-type cooler, Fig. 2. Float valve keeps several feet of liquid in cooler at all times. Liquid around the pipe coil cools liquid on its way to the low-temperature evaporator.

Keep gas-and-liquid cooler well insulated to prevent pick-up of excessive amounts of heat.

Use water at same temperature as in condenser for water-cooled intercooler. Gas-and-liquid cooler should bring booster discharge gas and liquid, going to coils, to within 10 F of saturation temperature of leaving gas. Cooler size is based on length of coil it must contain.

Booster Care. Most boosters used today are reciprocating, but you may also run into centrifugal types. When running a reciprocating unit be careful to prevent air from leaking through shaft seal. Do this by running a small line from booster discharge to shaft seal.

Don't allow frost to reach booster cylinders, no matter how low a temperature is carried. Frosted cylinders mean suction gas is wet. Liquid in gas can cause hammer, cut cylinder-oil film, foam crankcase oil and waste power. Easiest way to stop this is to have suction gas superheated a few degrees at all times.

When your booster has a separate drive, you can start and stop it without worrying about second stage if this has its own load. Second- or high-stage unit must be running before booster is started. Open precooler suction valve wide before you turn over booster.

Some boosters start with discharge open, suction closed. On others you must use starting bypass. When machine is up to speed, slowly open suction stop valve. Listen for liquid slugs that may be in suction piping. Turn on water or refrigerant to cylinder jackets before load is put on booster. Open liquid feed to low-pressure float and accumulator. Adjust expansion valve so frost comes back to scale trap or suction valve of booster, but no farther.

Close liquid feed to float and pump down system before stopping booster. If booster will be out of service more than a few hours, close suction stop valve.

Coupled Machines. With booster and second-stage machines driven by same shaft both compressors must be started together. High-torque induction motor with V-belt drive brings both units up to speed with discharge stop valves on the two compressors and second-stage suction open. Open booster suction slowly, adjust liquid valves as above after units are up to normal speed.

Synchronous Motor. When this type drives two machines you'll probably have to relieve starting load on second-stage compressor and maybe on booster as well. Close discharge stop valve, open both main suction valve and bypass to suction. Open booster main discharge valve but keep its suction stop valve closed. If motor won't start, open booster bypass.

After machines are running, open wide the main discharge valve of high-pressure machine; close bypass immediately. Safety valve pops when discharge isn't opened right. It's a good idea to have an alarm bell or cutout on booster discharge to stop motor if intermediate pressure gets too high.

Run duplex units a short while after closing liquid feed and booster suction valves before shutting down. This lowers pressure in intercoolers and pipes. Close main discharge valve, booster suction and discharge valves as soon as motor stops.

Don't run a booster with suction valve partly closed to regulate temperature. This causes high temperature in booster, may make oil pump fail from lack of pressure in crankcase. Bleed a little hot gas into suction to regulate temperature.

Piping. Keep pressure drop in piping between cooling coils and booster as low as possible. You can feed liquid refrigerant into top of coils, drawing gas from a drum or accumulator below them. Or a liquid circulating pump may be used.

Circulate from two to five times the amount of refrigerant evaporated. Have pipes of ample size. Loss of ½ psi in suction is serious when total compression ratio may be 77 to 1, as with ammonia at –80 F. It is serious with Freon at –120 F (200 to 1).

If you want to use ammonia at –80 F circulate 31 to 40 cfm of gas per ton. With Freon-22 at –120 F, 120 cfm per ton is needed, with Freon-12, up to 200 cfm. Allow 10 F superheat in each stage.

Motors. For driving compressors these must have enough capacity to handle overloads because pressures may vary widely. Some engineers oversize motors by 30%; others call for motors that can pull twice the normal load plus friction. Synchronous motor on duplex unit should have a starting torque of at least 50% with a pull-in torque of 40%.

Brines. Use calcium chloride, ethylene glycol or methanol for low temperatures. Watch viscosity and heat transfer. With calcium chloride at –40 F, pumping head increases while refrigerating effect may fall off as much as 40%.

If you need low temperatures in your plant, you can rely on a booster system to do a good job. But you must plan the system right, put it in properly and see that it is run as the builder recommends. Ideas in this article give you a good start for putting a booster in your plant. Get the advice of a good consulting engineer and machine builder.

WELL-KEPT air-conditioning units give little trouble; keep 'em fit with right care

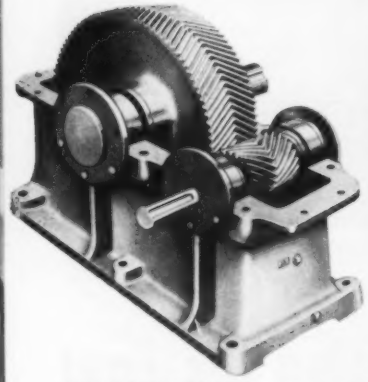
Don't wilt when air-conditioning trouble hits you. Just use this handy chart to . . .

Track Down Air-Conditioning Ills Fast

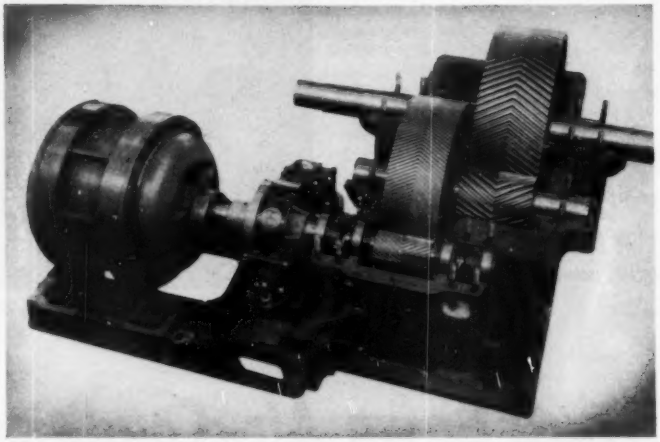
SYMPTOM	POSSIBLE CAUSES OF TROUBLE; CURES
HIGH HEAD PRESSURE	1 Not enough condenser water, or water too warm; check water-regulating valve, look for plugged pipe 2 Noncondensable-gas or air in system; purge until head pressure becomes normal 3 Condenser fouled; clean tubes, tube sheets, heads 4 Too much refrigerant; bleed excess to a drum 5 Evaporative condenser faulty; check and correct air and water flow; clean surfaces 6 Evaporative condenser too small; install larger condenser or use small watercooled unit for peak loads
LOW HEAD PRESSURE	1 Too much or too cold condenser water; adjust water-regulating valve 2 Not enough refrigerant; look for leak in system; repair; charge 3 Leaky compressor valves; check to see if suction pressure rises more than 2 psi per min in Freon units. If it does, overhaul compressor 4 Oil return valve or trap leaks; spot by feeling for hot oil return; repair or replace valve or trap
LOW SUCTION PRESSURE	1 Evaporator load light, causes compressor to short cycle; run at lower speed or fit capacity control 2 Clogged strainer; clean or replace strainer 3 Low-pressure switch setting too low; adjust 4 Compressor oversized; fit with a capacity control or run at lower speed 5 Hiss in expansion valve. This is caused by flash gas in liquid line. Cure by subcooling liquid 6 Evaporator pressure drop too large; fit an external equalizer to stop high superheat 7 Not enough refrigerant; look for leak in system; repair; charge
HIGH SUCTION PRESSURE	1 Too much load on evaporator; check conditioned-space insulation, fresh-air leakage, infiltration 2 Compressor suction valves faulty; overhaul 3 Expansion valve stuck open. With this trouble suction line will be too cold; repair valve 4 Evaporator oversized; run compressor faster or buy a large compressor 5 Low-pressure switch set too high; adjust 6 Expansion valve oversized; use smaller valve

SYMPTOM	POSSIBLE CAUSES OF TROUBLE; CURES
SYSTEM CAPACITY LOW	1 Evaporator pressure drop too large; use an external equalizer on expansion valve 2 Superheat adjustment wrong; fit external equalizer or adjust expansion valve 3 Clogged strainer, valve or pipe; clean or replace 4 Dirty cooling coil; clean dirt off coil; defrost to remove excess ice; check air flow to see it is normal after cleaning and defrosting
COMPRESSOR WON'T STOP	1 Temperature high in conditioned rooms; look for oversized fan, wrong damper setting or too much infiltration. See that rooms are insulated right 2 Discharge pressure high; check cooling water flow and temperature, clean condenser tubes or evaporative-condenser coil, purge excess Freon, air and noncondensable gas 3 Too low a temperature in conditioned rooms; check thermostat settings in the rooms, adjust to needed temperature; look for cold drafts that may be striking thermostat 4 Not enough refrigerant; look for leak in system; repair; charge 5 New heat loads in conditioned spaces; these may come from new or different production methods; increase compressor capacity or reduce heat load
ODORS IN ROOMS	1 Refrigerant leak; find, repair, charge, test 2 Brine leak; find, repair, adjust concentration and test piping 3 No trap in air washer drain to sewer; fit with suitable trap 4 Cooling-coil surface dirty; shut down air washer and clean coil; check intake-air filters for dirt 5 Odor-producing units near air intake; relocate odorous units or air intake
COMPRESSOR OIL LEVEL TOO LOW	1 Dirty strainer, tubing or valves; clean 2 Liquid slugs in suction; reset superheat, check to see thermal bulb is securely fastened 3 Not enough charge; look for leak, repair, charge system, and test with a halide torch 4 Suction line traps oil; repitch and fit loops 5 Oil separator faulty; repair, add oil, test

POSITIVE, QUIET SPEED REDUCTION EVEN ON HEAVY-SERVICE JOBS



SINGLE REDUCTION offers speed ratios to 10-1. Same lube for gears, bearings



DOUBLE-REDUCTION unit typical of those in service for many years and still doing a good job. Note sliding bearings; most units today use rolling-contact bearings

Herringbone-Gear Speed Reducers

Info on service factors, thermal ratings, installation and maintenance, by W L Byler, North Wales, Pa. Next month Bill will show how to avoid pitfalls in figuring size of H-S-R's

► THROUGH USE of speed reducers you reap the benefit of a high-speed high-efficiency motor drive, while meeting the lower speeds called for by the driven machine. A set of gears, chain, belt drive, or any of many commercial speed reducers on the market can handle speed reduction. But the modern parallel-shaft herringbone speed reducer (H-S-R) has cut its own little niche in the power-transmission field. It's a positive, quiet, economical unit.

When Used. There's hardly a speed-reduction job that an H-S-R can't handle. In general there are three speed-stages available, giving roughly the following speed reductions: *single* (1.25-10 to 1), *double* (11-75 to 1) and, finally, *triple* (80-360 to 1). Available hp ratings run from fractional to about 1000 on standard commercial units. And you can get larger units to order.

Service Factors. Catalog hp ratings at *unity service factor* are for continuous 8- to 10-hr service per day under uniform loads, allowing 100% momentary overloading. But all jobs don't fit neatly into this classification. Hence the need for service factors other than unity. Transmissions that must operate under more severe conditions, such as 24 hr continuously, reversing service or shock loads from driven equipment, need greater reserve capacity than steady service of uniform loads. This means a service factor larger than one. Required hp of H-S-R is product of actual running hp and proper service factor.

There are nine service-factor classifications, running from 0.50 to 2.50. Selecting a specific service factor hinges on (1) type prime mover (2) kind of load, and (3) hours per day normal operation. You can find tables in most manufacturers' catalogs that classify loads and pin down service factors.

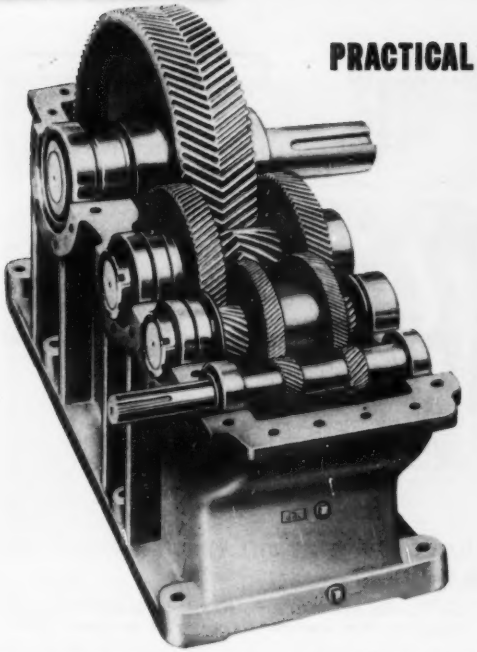
Thermal Rating. In addition to service factor you should know about thermal rating. This is a second rating-standard, which indicates ability of reducer to rid itself of heat generated within unit.

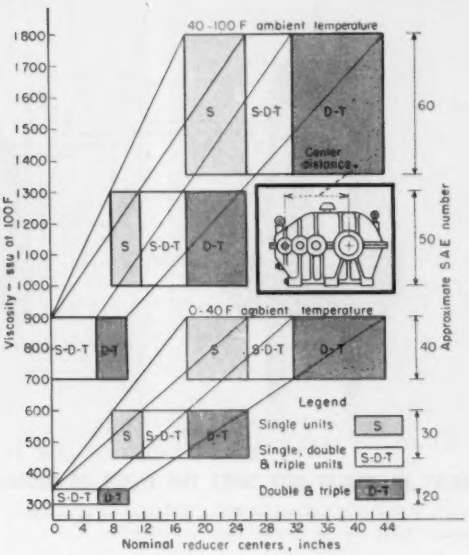
Single-reduction units are most sensitive to thermal ratings. On the other hand, double-reduction units are critical in the lower ratios and less sensitive in the higher. Triple-stage units are virtually unaffected by thermal ratings. Here's why. Consider a single-reduction unit with a pinion driving the main gear. Here the large gear rotates at high speed, whipping up oil in reservoir.

Large gear picks up oil from reservoir to lubricate gear teeth. In addition, oil splashed against reducer housing is caught in channels and fed to bearings. Shearing of oil by gearing, especially at high speed, generates heat. This heat plus heat from turbulence must be given off by surface area of housing. Large gear rotation is much slower in a triple-reduction unit; hence turbulence is reduced. Result is less heat generated and thermal capacity of unit ceases to be a problem.

Manufacturer tells you what thermal ratings are for each of their units. *Don't apply service factors to thermal ratings.* Thermal ratings have to do only with actual hp transmitted regardless of whether load is shock or non-shock. Thermal ratings indicate actual

PRACTICAL GUIDE FOR PROPER LUBRICATION





TRIPLE REDUCTION offers ratio of speeds between 80-360 to 1. Efficiencies of an H-S-R run anywhere between 95 and 98%

VISCOSITY SELECTION is important but don't overlook (1) maintaining oil level (2) changing or filtering oil when needed

hp that can be handled for long spells (over 3 hr) without overheating and without supplementary cooling.

Installation. Maintenance of modern H-S-R is a cinch if she's selected wisely and properly installed. Provide a good foundation, then grout unit in place after carefully aligning shafts and leveling the reducer. Grouting prevents springing or shifting when the foundation bolts are tightened. It's best to use a single baseplate to support motor and reducer as a unit.

Usually flexible couplings are used in connecting shafts. Allow enough end float between motor and reducer shafts so motor's rotor will operate in its true magnetic center. Coupling fit on shaft should be snug, but not so tight as to require hammering. Flexible couplings are no excuse for sloppy workmanship or poor lineup.

Maintenance. Routine maintenance after installation is generally confined to maintaining proper oil level in reducer and inspecting oil to see that it is clean. Most modern H-S-R's are now equipped with a filter-type breather over the oil breather pipe. Keep metal-meshing in it clean and soaked with clean oil.

Manufacturer will recommend correct oil level or oil capacity. To help in oil inspection, install a petcock in oil drain hole. Then a small amount of oil can be withdrawn for inspection. If it appears clean, and the oil level is correct, no further attention is generally needed. A shallow pan painted white is useful in inspecting condition of oil. If possible, locate petcock under high-speed pinion. Turbulence in oil is least at that point, letting dirt settle in this relatively quiet zone.

Location of reducer will have much to do with frequency of inspection. Maintenance timetable can be guided by simple oil test described above. Reducers in unusually dirty locations may need oil changes every week. Others installed in clean, dry and protected areas may not need attention for six months to a year.

When intermittent overloads or unusual temperature swings cause the oil to heat and cool off quickly, sweating on housing walls results. This sweating forms sludge and contaminates the oil. This means more frequent oil changes are a must.

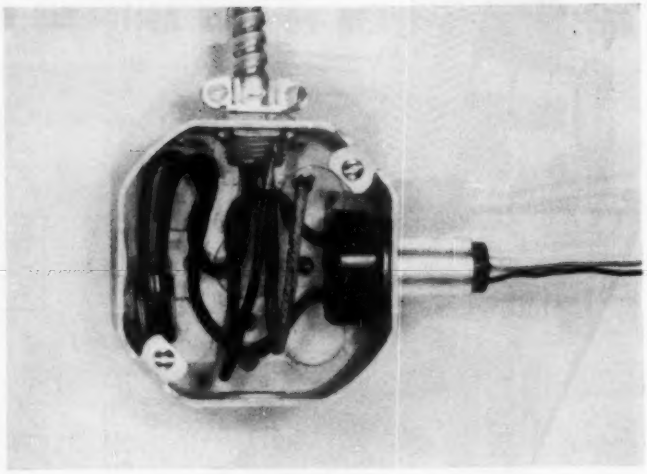
When reducer is first placed in service, fill with proper lubricant and run for no more than two weeks. At end of this period drain and refill with new oil or filter the old. It is smart to flush reducer housing with a light flushing oil. During run-in the unit will wear off any rough machining edges on gears. These small particles will damage gears and bearings if left in the unit. It is well to repeat this flushing precaution several times before settling down to a longer oil-change interval.

Lubrication Guide. General recommendations are difficult to make. Operating conditions, size, type and ratio enter the picture. For ordinary service, it is best to use a high-grade, straight mineral oil. Avoid extreme-pressure (EP) lubricants containing sulfur. If operating conditions are tough, use an extreme-pressure lubricant made with lead naphthenate. Don't use grease or graphite in H-S-R's designed for "splash" or oil-bath lubrication.

Operating temperature of oil, inside the reducer housing, should not exceed 180 F, nor drop below O F. When these limits are exceeded, consult gear manufacturer or lubricant supplier.

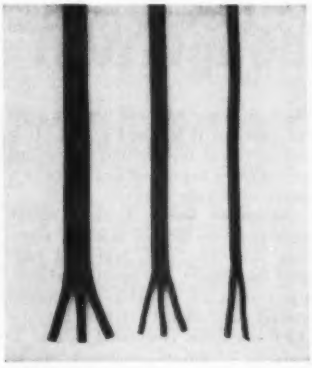
Chart above is a general lubrication guide under normal plant conditions. Plot is for viscosity vs unit center distance to cover different makes of reducers without confusion. Machines equipped with rolling-contact bearings are considered standard. Reducers with sliding bearings call for a compromise in lubricant viscosity to provide oil that is thin enough for bearings and yet retains sufficient body for gears.

Look for figuring size, next month.



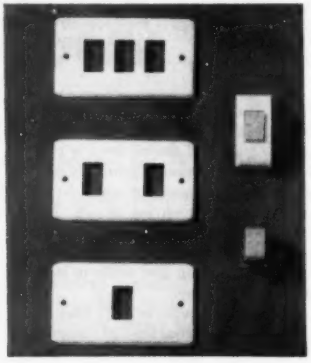
RELAY IN OUTLET BOX DOES THE WORK OF REGULAR SWITCH

With l-v control system, power wiring does not run to switching points. Relay can be spotted right in outlet box. L-v wiring runs to switch locations. Relay shown has two coils; one closes circuit, the other opens it. L-v wiring OK to about 1500 ft



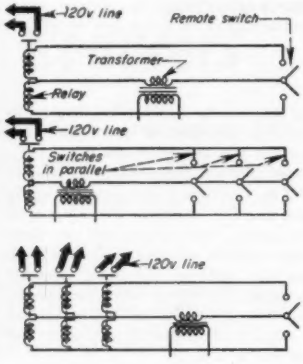
TYPICAL WIRING . . .

Typical l-v wiring. Different types for indoor and outdoor use. Feed is 2-wire



. . . SWITCHES . . .

Single or grouped switches (for 3-wire system here) can be fitted in usual box



. . . HOOKUPS

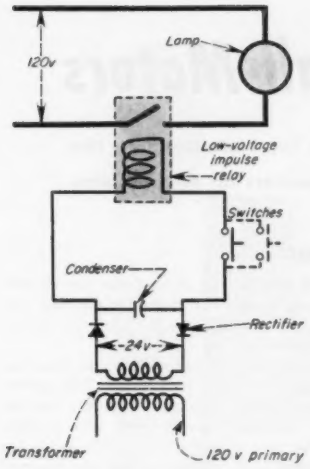
Remote loads simply handled with 3-wire system; switch shows if load's connected

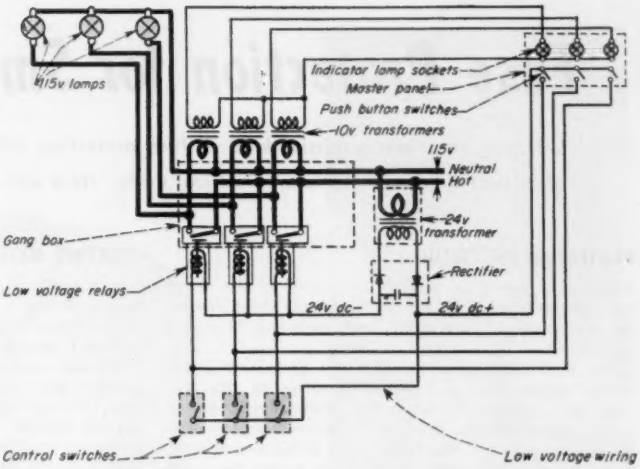
L-V Relays Cinch Lamp Switching

You can get more switching points in lighting circuits with low-voltage wiring. Jim Sparks in Chicago, Ill. shows how

► FOR THE PAST FEW YEARS I've watched the growth of low-voltage (l-v) control wiring. Up to now, it's been mainly outside the power field. Biggest uses have been in home building. But unless I miss a bet, tomorrow will see more and more applications right in our own bailiwick.

What It Is. Every electrical man knows the problem of controlling lights —that is turning them on and off— from more than one point. Adopting the long-used wiring methods means in-





THIS SYSTEM USES ONLY TWO WIRES BETWEEN RELAYS AND SWITCHING POINTS

L-v impulse relay operates off 24-v dc line. Additional switches in parallel

Here's how to handle switching from a remote point with the 2-wire system. Pilot light tells when load's connected. Don't operate more than one relay from switches

stalling 3-way and 4-way switches in "hot" leg of load circuit. This is a mighty expensive way of turning a few lights on and off. Then l-v control entered the picture.

Big difference between regular switching and the l-v method is voltage and current handled. With conventional single-pole, 3-way and 4-way switches, all switches and wiring must take full circuit voltage and current.

Often the load may be only a few hundred watts. But if you want to control those few hundred watts from several points, you've had to run conduit or cable, and install switch boxes and regular switches.

But with l-v wiring a small relay is installed at or near the load, and small l-v control wires are run to the control points. Then at each control spot a simple l-v switch is used. I'll grant you the basic idea is not new. I can remember installing single- and double-pole magnetic switches at load centers to handle big chunks of lighting. Switches were then connected in the coil circuit of these heavy-duty magnetic switches. But this was only for sizable lighting loads. L-v solves the problem of lighter loads, somewhere in the 0-15 amp range at 125 v.

Where Used. Where l-v switching can be used in your plant is for you to decide. However it seems to me there are several obvious applications in new and old plants. For instance, watchman circuits giving a path of light without using all lights on a floor. And there's stairway lighting you may want to control from several points.

Stock-room lights are another possibility. Now they can be easily controlled from several points as well as from the stock-keeper's desk. There are applications outside the plant, too. Protective yard lighting along with general-purpose yard lighting can be controlled from the guard's office and other central locations. These are simple off-the-cuff application ideas. Whether they can be used in your plant in place of conventional switching is a problem in practical economics.

Fluorescent Lighting. You fellows that handle maintenance in office buildings and plants may be brushing elbows with the new 480-Y/277-v systems for fluorescent lighting. Control is generally handled in large blocks from magnetic switches, but controlling small loads has been a stumbling point. Conventional toggle switches have a maximum rating of 250 v. And switches carrying a rating of 251-600 v are too large and costly for general use. In fact, one objection to the 480-Y/277-v system has been the higher voltage hazard. Now the problem can be solved neatly with l-v wiring systems.

How L-v Works. There are several systems of l-v control on the market. But basically they all have three simple parts. First is the relay that does the actual switching. Coil of this relay operates from a 24-v circuit. Second part of the system is the wiring between relay switch and transformer. Since this is but 24-v and low-current, you don't need regular wiring and conduit. And lastly is the switch.

There are differences in the several systems available. One uses a 2-position switch (ON and OFF) as shown on the facing page. For this system you need three wires between relay and switch. Another system uses what amounts to a pushbutton and two wires.

With the 3-wire system the relay has a double coil. One of the coils closes the circuit; the other opens it. Relay takes the place of the conventional switch. In either system you can use as many switches as needed. Just connect them in parallel as shown.

The 3-wire system shows by switch position whether load is ON or OFF. This plan can be used where you can't see whether load is ON or OFF from control points.

With the 2-wire pushbutton system one push of the button closes load circuit, next opens it. So if your control points are out-of-view of load, this method has a drawback. But you can still use the 2-wire system if you install a pilot light at each switch. Manufacturer can supply this pilot-light arrangement. Hook it up as shown in sketch above.

Not all l-v relays can be mounted right in outlet boxes, as shown on facing page. One manufacturer of a 2-wire system suggests the relay be mounted in a separate box. But the 3-wire relays can generally be mounted right in outlet-box knockout.

Fuse Protection for Small Motors

Selecting the right size and kind of fuse protection calls for understanding the electrician's gospel—National Electrical Code. Here are pointers on motor fusing

PROTECTING THE CIRCUIT

Speaking of motors in general, two points in the circuit must be protected: (1) the branch-circuit wiring feeding the motor, and (2) the motor itself, including its control apparatus.

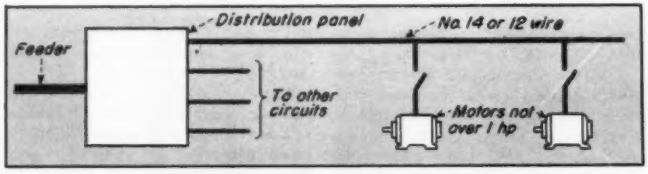
The first, called motor-branch-circuit protection, guards circuit wiring, motor and control apparatus on *short circuits and grounds*. The second type, motor-running protection, is the safety valve that guards the motor against overloads, single phasing, etc. It also protects the motor-control apparatus and the branch-circuit wiring against too much heat from overloading. But small motors are different.

STARTING METHODS

Any manually started motor, 1 hp or less, that can be seen from a starter location doesn't call for motor-running protection. Branch-circuit protection does the trick. If motor's over 50 ft from starter, it's called out of sight.

But with automatically started motors 1 hp or less, you generally need running protection. This shouldn't be greater than 125% of full-load rating for motors having a marked rise not over 40 C. For other than 40-C-rise jobs, running protection shouldn't be greater than 115% unless motor has built-in overheating protection. For exceptions, see National Electric Code, 1951, sections 4322B and C, also section 4343.

Protecting Several Motors On One Branch-Circuit Feeder

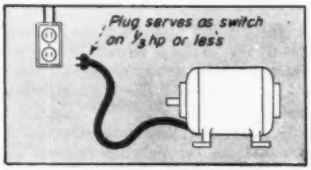


TWO OR MORE MOTORS ON SAME CIRCUIT

Important angle here is that motors don't need motor-running protection—unless they're automatically or manually started but out of sight. Both discussed above.

Keep fuse size to 20 amp or below at 125 v. And not over 15 amp at higher voltages. For motors above 1/3 hp, you'll need some sort of start-and-stop switch. Only limit on connected load in this circuit is ability of right-size fuse to carry the load. Full load rating of each motor should not be greater than 6 amp.

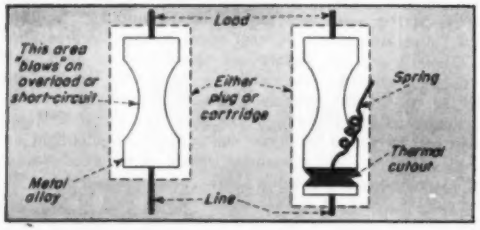
Remember these are minimum requirements. Keep in mind that in most cases you can get motor-running protection at little extra cost by using time-delay fuses.



PORTABLE MOTORS

There should be no confusion about small portable motors. With 1/3 hp or less the plug can serve as controller for starting and stopping. Use No. 18 ordinary cord up to 4 amp; No. 18 heater cord to 8 amp. On heavier loads use No. 16 ordinary cord to 5.6 amp, and No. 16 heater cord up to 12 amp.

Time-Delay Fuses Give Close Motor Protection



ORDINARY AND DUAL-ELEMENT FUSES

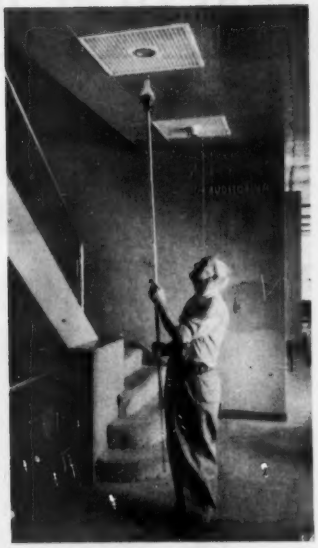
Helical spring is connected to junction of fuse link and the thermal cutout. On dangerous overloads solder in cutout melts, allowing the spring to pull fuse link to open motor circuit

Time-lag fuse came into being to eliminate blowing on momentary overloads. On short circuit it opens with the same speed as the regular fuse. You can see how such a device is well suited for protection of motor circuits where large starting currents would blow a regular fuse. This type is available in both plug and cartridge form.

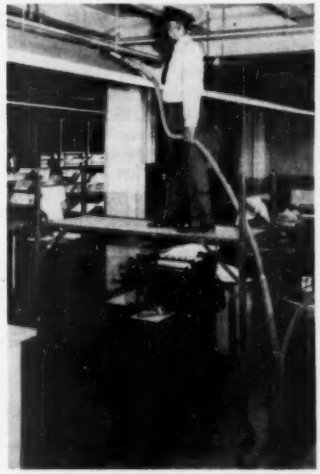
Of the different types, some have time lag at 200 to 300% load. These in themselves prevent needless shutdown. This type doesn't have the dual element. Time lag is had by increasing heat-storage area within fuse.

But dual-element time-lag fuse consists of regular fuse in series with a thermal cutout. This type's often used with small motors. Fuse link opens on short circuit, but won't blow on short-time overloads. But if overload hangs on thermal cutout operates. Generally, dual-element type gives longer time lag on momentary overloads, yet pops like a regular fuse on short circuits or grounds. A good investment.

MAINTENANCE RIG holds all essentials for changing lamps in a specific area. One man handles it easily, like a wheelbarrow. Filament and fluorescent lamps, starters, tools are all there



LAMP changers can handle lamps to 30 ft. Filament lamp changer tokes 10-1000 w. Fluorescent changers are available also



PLATFORM solves many maintenance problems. Made of wood, steel, aluminum; adjustable legs span uneven floors

VENTILATED reflectors cut dirt buildup. *Left*, nonventilated; *center*, holes near socket; *right*, housing holes—least dirt

Lamp Maintenance Tips

Give thought to better lighting maintenance . . . it pays off in more light, fewer trouble calls. Info from General Electric Co

► KEEPING LIGHT OUTPUT up simply means an organized lighting maintenance program. Even in the smallest plants, that starts with fixing responsibility on (1) lamp and reflector cleaning, and (2) lamp changing. But you've got to set the pace. You've got to show a real interest in better lighting; otherwise, the best-made plans will fold in time.

Cleaning. You're getting gypped when you let dirt build up on lamps and reflecting surfaces. You're paying for the light but never getting it. The most sensible basis for a cleaning schedule is a light meter. Buy one; it will soon pay off itself. Then strut through the plant after all reflectors, lamps, walls, etc, are clean. Take a light reading.

See how long it takes for dirt to build up. You can check that with the same light meter, and your good sense will soon tell you how often the cleaning squad should tackle every fixture.

When you've hit on a practical cleaning schedule, equip your crew with proper tools. The rolling platform, right, is a fine addition where low machines are spread widely. A good investment from the safety angle, too!

By the way, swishing a rag merely moves the dirt from one place to another. Invest in an industrial vacuum cleaner with all necessary attachments. Then follow up to see that the job is being done. The best detective is your light meter. A low reading means the crew gave a lick and a promise.

PRACTICAL IDEAS... *here's the trading post for your*

UNIT HEATER COOLS CHIEF'S OFFICE

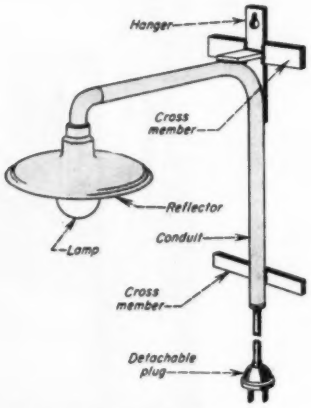
LIKE MOST chiefs' offices in large hotel plants, mine is stuck away in the hottest corner of the engine room, down below the street level. When I first took over a few years ago, my office was usually around 100 F. It's hard to do a good job under such conditions.

I took one of our small unit heaters, and had my boys install it in the wall above my desk. Then we piped it up to the brine-cooling system. Because brine temperature is fairly constant, inlet valve is adjusted so it keeps office temperature at about 70 F.

To keep fan in back of coils from blowing cool air directly across my desk, we installed a small baffle, or directional vane as shown. That shoots the air up toward the ceiling.

Now, this office is comfortable the year round and totally isolated from the hot engine room.

W A GRACE *Buffalo, N. Y.*



Portable Lamp Ups Ashpit Lighting

CEILING LIGHTS are not adequate when our ashpit room is fogged during dumping operations. Lamps on extension cords are likely to get broken and the cords damaged. To solve this problem we put in a 32-v system with outlets at all furnace openings.

Portable lamps for this system, like the one in the sketch, have an eye to hang them on a bolt in the wall. The lamp is near the floor where light is needed, without being in the workmen's way.

Since the lamps are so easily moved, two take care of our five boilers when cleaning one after the other. Lamps, put together by our welder, have simple construction. The cross members make the units quite stable when hanging from a single bolt on a wall.

Shades are oldtimers, recovered from the scrap pile because their reflectors are more efficient. We expect the lamps to take a beating so did not risk anything fancy on them.

T E MILLER *Chattanooga, Tenn.*

Quick Bearing Repair Keeps Exciter Running

A BEARING on a belt-driven exciter wore on the tension side and let the armature rub the polepieces. Operating conditions did not allow us to shut down the exciter more than two hours at one time. But we decided to take out the bearing and have the machine back in service in the allowable time.

We found the bearing to be a brass bushing pressed into a cast-iron sleeve. With a hacksaw we slit the brass bushing through the thin or worn side, making a cut about 1/16 in. wide.

After making a brass shim, we placed it on the outside of the cut and forced the liner back into the sleeve. This closed the cut in the sleeve and increased the thickness to about the original on its worn side. We then put the bearing in a lathe and bored it to fit the shaft. We got a new bearing as soon as possible, but the old one lasted a long time before it was replaced.

A G WIGGINS *Cleveland, Ohio*

Draft Gage Corrects Boiler-Firing Trouble

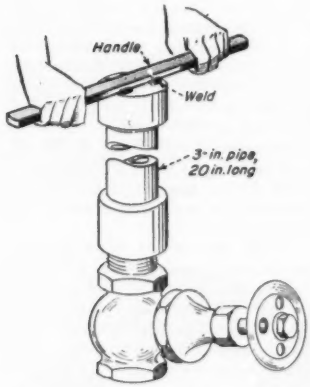
WE OPERATE four horizontal-return-tubular boilers connected by a common flue to a brick chimney. The fireman complained of poor operation from No. 1 and 2. These were farthest from the stack. The other two boilers seemed to fire easier so the firemen centered their efforts on them to keep up steam pressure. No. 1 and 2 were allowed to drift along as best they could.

The plant had several meters to assist operation, but did not have draft gages. Several trials with damper adjustments and fuel-bed thickness did not solve the problem. We then rigged up a U-tube from gage glasses and

rubber hose. With this we found that draft was 0.2, 0.3, 0.7 and 0.9 in. on boilers 1, 2, 3 and 4, respectively.

With the assistance of the U-tube we regulated the draft on each boiler to about 0.7 in. This gave satisfactory operation. As a result of this test, we installed a draft gage on each boiler. This made operation easier for the firemen, saved fuel, and we could operate with only three boilers.

R O SPENCER *Philadelphia, Pa.*

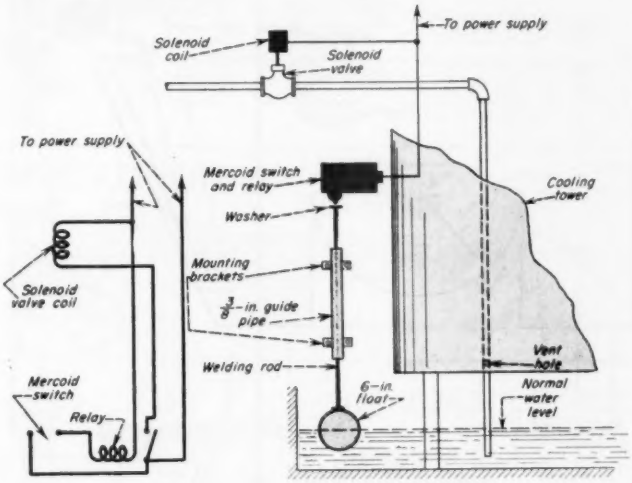


Compound Feeder

HERE'S a handy compound feeder for small boilers. Just take a length of pipe threaded on both ends, screw on a pipe cap and weld a piece of strap iron to cap, for a handle.

Then screw into the feed pump-discharge line with a valve under it. To feed compound, close valve, remove cap, fill with compound and screw down cap. Then crack valve so compound feeds into boiler gradually.

E A GREGORY *Reedsburgh, Wis.*



SOLENOID VALVE HOLDS WATER LEVEL

AT OUR DAIRY we have a cooling tower with a 1-in. makeup water pipe. A float switch-controlled water flowing into the tower's basin, but it did not work well.

We then tried hand control with a globe valve. With this, the human element failed. The fireman would open the valve and sometimes forget it until the tower basin overflowed. In winter, the overflow would freeze and cause a dangerous condition.

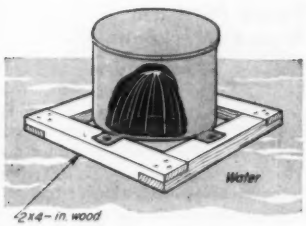
Because the discharge end of the makeup line was sealed it did not always drain and in cold weather would freeze. We stopped this by drilling a vent hole in the pipe above the overflow level of the water in the tower's basin.

To solve the overflow problem we installed a float, a mercoid switch and a solenoid valve. The 6-in. copper float has a 4-ft length of welding rod threaded into it. This rod is guided by a 24-in. length of 3/8-in. pipe. A washer at the top end of the welding rod contacts the mercoid switch, as in the right-hand diagram.

Float guide and mercoid switch are mounted on the side of the tower. Switch connections are arranged so as to close the solenoid valve. When the water level drops the float releases the mercoid switch and it closes to open the valve. Electric connections are shown in the diagram on the left.

This new hookup, which has been in over a year now, has been working so well we seldom have to check it.

RICHARD E TEST *Dayton, Ohio*



HALF PAILS KEEP ROOF DRAINS FREE OF FLYASH

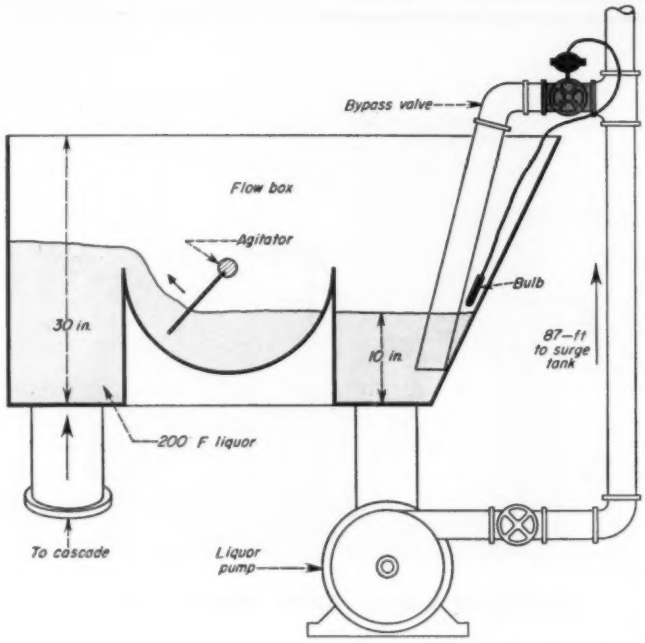
WE BURN North Dakota lignite and have trouble with flyash plugging roof drains in our plant. Besides flooding the roof, this trouble takes mechanics from their regular work to open the drains.

To correct this condition we cut large paint pails in half. Each half, with its bottom up, we attached to a 2x4-in. wooden frame and placed over a drain screen. The pails keep the flyash out of the roof drains and the wooden frames will float and let water on the roof drain off under them. We used half pails instead of whole ones to reduce their weight and increase the buoyancy of the unit.

S KRONE *Fergus Falls, Minn.*

For more Practical Ideas, turn page

Begins on page 128



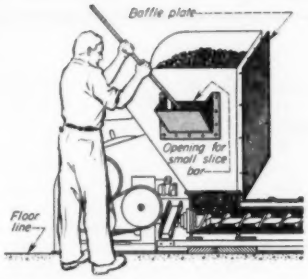
HOLDS PUMP SUCTION CONSTANT

WE HAVE an 87.5-ton black-liquor recovery boiler system. In it a pump discharges the liquor containing about 65 to 70% solids against an 87-ft head to a surge tank. This pump takes suction from a flow box, as in the drawing. It operates under severe conditions, low suction head, pumping liquor at high discharge head.

The flow box takes suction from a large agitating storage system, called a cascade evaporator. The pump burned out bearings, because of suction head loss in the flowbox. After considering several methods of correcting this trouble, we solved the problem, as in the drawing, with an air-operated valve actuated by temperature of a thermostatic bulb as liquid level changed.

When liquid level drops, more of the bulb is exposed to the air. As the bulb's temperature drops, it opens the bypass valve to return more liquor to the flow box and hold the level nearly constant. We can hold the flow-box level within 1 or 2 in., and have stopped pump-bearing burnouts altogether now.

G E BOYHAN *Ticonderoga, N. Y.*



Stops Stoker-Hopper Corrosion

ON OUR UNDERFEED STOKER the rear side of the coal hopper gradually corroded on its inside surface. Other sides of the hopper were not affected. I, therefore, assumed that the corrosion was caused by sulfur in the coal in the presence of heat from the boiler front.

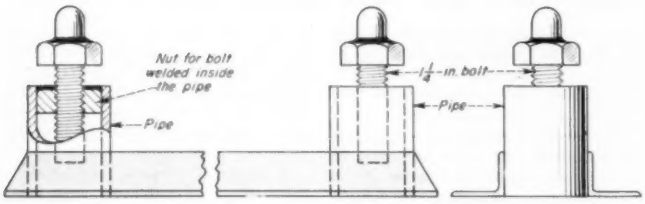
I installed a baffle plate of No. 16-gage galvanized iron as in the drawing, about 1.5 in. away from the hopper. Corrosion has stopped, or at least is not noticeable any longer.

On the same stoker, when we were burning damp coal at times, it did not flow to the feed worm. I noticed that the side of the stoker's hopper was dented. Checking with the night engineer I found he was using a heavy hammer to loosen the coal from the hopper's sides.

To correct this condition I cut a hole in opposite sides of the hopper and attached a small hopper as in the drawing. These hoppers prevent coal falling on the floor, yet allow the engineer to use a small slice bar to loosen the coal. This bar is not long enough to reach the worm. Now that our stoker troubles are cured, everybody is happy.

This is just another case of applying a little common sense before any serious damage is done from various causes.

RUDD BOTTINGER *Hoboken, N. J.*



Truck Platform Makes Workbench

WE FIND OUR PLATFORM TRUCKS useful for overhaul work on motors, pumps and other equipment. A 100-hp motor can be taken off its base, put on the truck and rolled out to the electric crane for dismantling. This is done right on the truck to save costly manhours.

(*Continued on page* 132)

These are the things to look for in BLOW-OFF VALVE Design

And you get them all in EDWARD

Boiler blow-off valves take real punishment. Wide and rapid variations in temperature and the abrasive action of scale blown through the valves are conditions prevalent in blow-down service.

Edward cast and forged steel blow-off valves are built to withstand these conditions — without bulky metal sections that add to weight and cost and distort in service and without additional special parts that complicate maintenance.

Before you specify blow-down valves, investigate Edward designs, and more important, the performance records of Edward blow-off valves in all types of stations.

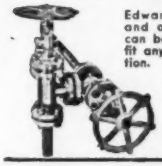
SIMPLICITY

Few working parts to wear, easy disassembly, and wide interchangeability of parts add up to simple maintenance.

TIGHT CLOSURE

Coefficients of expansion of materials are such that an Edward valve closed tight at high temperature is still tight when cooled.

PIPING FLEXIBILITY



Edward straightway and angle designs can be combined to fit any space limitation.

SLOW-OPENING

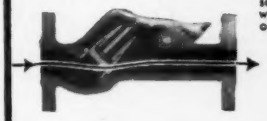
Slow opening design eliminates damaging shock to piping when valve is operated.

EASY REPACKING

Pressure tested backseats, large stuffing boxes and bolted gland make repacking easy.

STREAMLINED

Smooth internal contours permit free passage for sediment and scale without clogging or eroding parts.



LONG LIFE

For nearly three decades these Edward blow-off valves have been in continuous service in a Chicago plant. A typical case.

SEND FOR CATALOG 12-D

Complete data on designs, dimensions, installations and operating suggestions. Yours for the asking.

Edward Valves, Inc.

SUBSIDIARY OF
ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA
1220 W. 144th St.

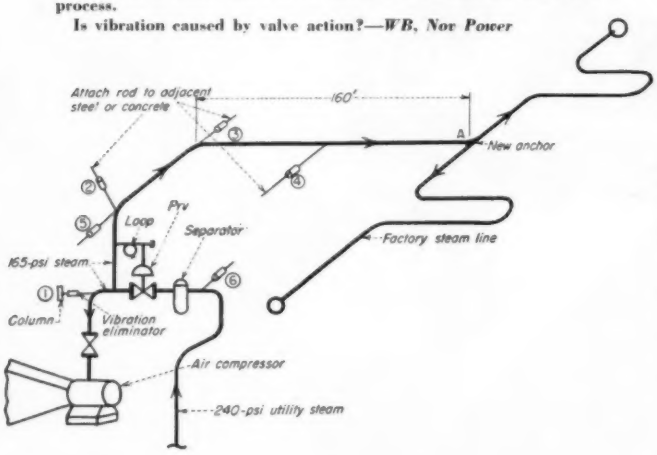
PLANT PROBLEMS ... *put your know-how to work*

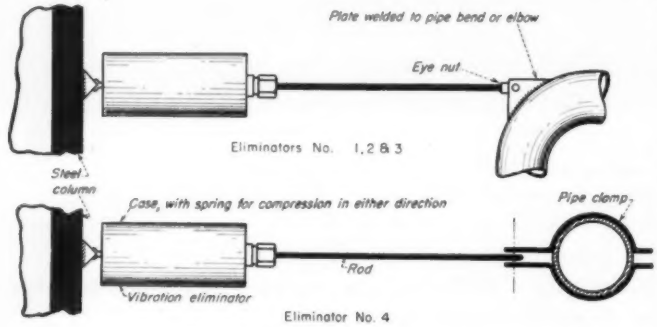
WHY DOES PIPELINE VIBRATE AT TIMES?

HERE ARE THE FACTS: We have a 6-in. 165-psi line running overhead. Supported by flexible hangers, it has expansion bends every 100 ft. At intervals of about 2 min it starts to vibrate, the movement growing in intensity. After a minute vibration stops; then it starts all over again. This has been going on three years, ever since plant was built.

Utility steam comes from pipe below floor [sketch, p 139, Nov *Power*]. It goes through a 165-psi reducer to a large 2-stage steam-engine-driven air compressor. Beyond reducer, line branches to factory 160 ft away. There it tees into long overhead line supplying process.

Is vibration caused by valve action?—*WB, Nov Power*





Here Are the Answers

VALVE ACTION of steam engine causes *WB's* steam-line vibration. Pressure waves caused by steam cutoff are transmitted to steam line. Also, pressure change causes pressure-regulating valve (prv) to vary its port opening. This changes flow quantity, causing more vibration of the entire factory line.

Check engine valves. If they work OK, fit four vibration eliminators at points labeled 1 to 4 in sketch. Attach eliminator to building steel or concrete.

Install eliminator *1* so rod is on center line of pipe containing prv; *2* is at an angle with elbow, *3* absorbs any direct thrust from line, and *4* is midway between *3* and a new anchor at point *A*.

Smooth prv hunting by putting a loop in control piping to valve diaphragm.

A J Breugelmans *Hoboken, N.J.*

COMPRESSOR CYLINDER is a dead-end point. Vibration comes from compressor steam-cylinder valves, prv and possibly the compressor frame. Without snubbers vibrations in one part of system are easily transmitted to another.

Put in snubbers *1* and *5* to prevent horizontal movement and relieve bending stresses on cylinder flange. Use another snubber at *6*, and anchor factory line at *A* for best results.

Howard T Livingston *Los Angeles, Calif.*

SUPPLY FACTORY LINE from a separate connection taken off beyond separators. Fit with a new reducing valve. This will cut pressure waves from compressor considerably, stop vibration.

D J Parmer *Quincy, Fla.*

WATER HAMMER caused by condensate collecting in leg to compressor could set up vibrations. Take air-compressor connection from the top of the reducing-station line. Treat line with prv as a header and trap end.

Gerald J Troske *Midland, Mich.*

CUSHION PULSATIONS with a large receiver-type separator close to air compressor. *WB* might also try lengthening point of cutoff of engine valves. How well this would work depends on type of valve gear and governor on engine.

R E Fontaine *Kenmore, N.Y.*

PUT GAGES in steam lines and you'll see that there are pressure pulsations in both 165- and 240-psi pipes. Get a magnifying glass and watch stem of prv. I believe *WB* will see stem move through a cycle at regular intervals. This shows that pressure pulsations synchronize, causing line to vibrate.

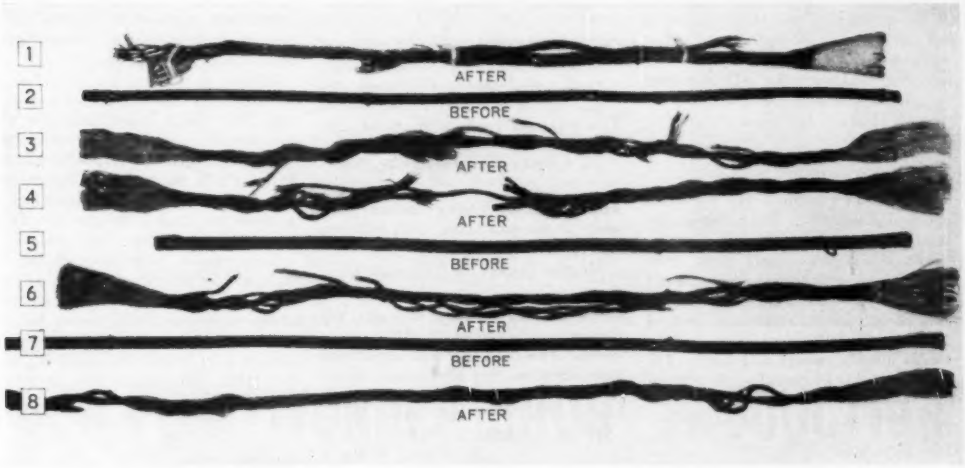
To stop pulsations from reaching prv, connect control line from diaphragm to 165-psi line as far as possible from compressor. Don't hook directly into main. Instead, connect it to a 6-in. cylinder 1 ft long. Cylinder is connected to main with a ½-in.-dia nipple.

J E Gleason *Plymouth, Mich.*

COMPRESSOR VALVE action doesn't cause vibration. Most likely cause is the prv. It is probably set to a very

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*



MORE ANSWERS TO THE OCTOBER QUESTION ON ELEVATOR-ROPE RENEWAL

ROPE RENEWAL is a lot like driving a car along a highway. If you see a train approaching a crossing and stop half a mile from it you're safe. But you'd be just as safe from being hit if you stopped 100 ft from the train.

Some elevator inspectors in Canada condemn ropes with six broken wires in any 12-in. length. I've often wondered why we couldn't allow eight or ten broken wires per foot before condemning the rope. We find that after a set of ropes has been condemned and changed little is done to see how much strength the ropes still have. If condemned ropes were tested, we might learn that eight or ten broken wires could be allowed before replacement. This plan would save money and materials.

Of course, you'd finally reach a point where it would be unsafe to use ropes any longer. But let's say our first condemned set with six broken wires carried a load of 22,600 lb before breaking. If we allowed the second set to run until eight wires broke, we might find strength to be 20,960 lb. Third set might then be allowed to run until ten wires were broken.

Photo above shows a number of ropes before and after we tested them for strength. Rope *6*, a new ⅝-in.-dia. piece, failed at 27,100-lb load. Rope *5* had 35 broken wires per ft, failed at 22,700 lb. This is a difference of less than 5000 lb between new and old rope.

Rope *3* with 16 broken wires per ft failed at 17,400 lb. Ropes *7* and *8* were condemned with only two broken wires per ft. Rope *8* failed at 24,300 lb. Rope *1* had eight broken wires in one spot. It failed at 20,200 lb.

These samples show a few of the tests we've made. We're still trying to find a safe way of getting longer life from our elevator ropes. It irks us to learn that some condemned ropes have a strength greater than 90% of the original.

You'll note that most of these tests were based on ropes with broken wires. Where ropes are abraded the story may be different. We don't know yet.

H H BRYAN *Montreal, Can.*

IN OUR PLANT we don't take chances. When we replaced four hoist cables recently, we cut 2-ft sections from the cables and sent them to a lab for tests and analyses. The cables were badly rusted and we expect to get enough info from the lab to prevent this in the new set. This will cut costs.

NORMAN EBLING *Portland, Ore.*

ELEVATOR CABLES seldom if ever break without showing wear first. Have different people make regular checks. Scrap old cables. They can be put to very good use by defense industries.

CLYDE G HOWARTER *Canton, Ill.*

For your two new problems from Power readers, turn to page 138

narrow range. Try removing valve to see if vibration stops. If *WB* finds he no longer has vibration he should change valve setting or purchase another type that a narrow setting won't affect.

OLIN L BRAGE *Oroville, Wash.*

PRODUCTION UNITS may shake building and piping. Large presses and similar equipment have been known to do this. If this isn't the cause, then water hammer, engine valve action or wrong pipe hangers probably is.

Water hammer is caused by wrong pitch of pipes, traps out of whack or fittings that collect condensate because they are installed wrong. If engine valves cause vibration, *WB* would be wise to see a pipe-hanger manufacturer.

Check to see that separator ahead of engine removes excess moisture from steam.

If process units are fitted with quick-opening valves or prv's there may be sudden stoppage of flow that is followed by vibration. Bypasses may stop vibration from these sources. If they do, see

More PLANT PROBLEMS

Begins on Page 134

a pipe-hanger manufacturer for his recommendations.

I think *WB* would be much better off if he used individual reducing valves for power and process. Or he can eliminate reducing valves by reducing boiler pressure from 240 to 165 psi. Of course, this depends on what other demands he has for steam in his plant.

ART CANNON
Laurence Harbor, N. J.

COMPRESSOR LOADING and unloading cause pipe vibration. When compressor is raising air pressure the steam engine draws steam from line. While compressor runs unloaded, engine doesn't draw much steam because it supplies only enough power to overcome friction.

Prv can't follow engine steam demands quickly enough and hunts. *WB* might stop this by throttling the control line running to valve diaphragm.

AL KEELING *Parma, Ohio*

TROUBLE STARTS in the 240-psi piping. Condensate collecting in short horizontal run ahead of separators backs up to fall down riser. This sets up water hammer or causes condensate to flash if steam is hot enough.

Use larger traps on separators and insulate horizontal run. If already insulated, try adding another thickness of covering to entire pipe.

JOHN B PRATHER *Yonkers, N. Y.*

CHECK VIBRATION to see if it occurs at a particular compressor speed or during a small speed range. If it does, run compressor at a higher or lower speed. This may take compressor out of critical-speed range in which pipe vibrates.

J L AIKMAN *Drummondville, Que.*

ANCHOR LINE feeding factory main where it ties into main. This will stop side thrust of the pipe.

MELVIN EVANS *Chicago, Ill.*

SWAY BRACES installed in pairs will change natural frequency of the piping system. This is an excellent way to stop pipe vibration. See pipe-hanger manufacturers for best methods of using sway braces. They have good dope.

H A KANNIAINEN
St. Albans, W. Va.

CONDENSATE TRAPS in *WB's* plant may be too small to handle load, causing water hammer. Check piping to see that it is large enough for steam load and that there isn't any feedback. If traps are too small, install larger ones.

CLYDE G HOWARTER *Canton, Ill.*

SHUT DOWN COMPRESSOR for a few minutes and watch factory line to see if it still vibrates. If it doesn't, you know compressor is cause; if it does, you'll have to continue looking. This is a good approach to the problem.

It looks to me as if the steam line to the engine is too close to prv's control tap. This could cause hunting of the prv. Besides, piping isn't anchored right and steam separator is poorly placed. It doesn't do much good in its present location because it's at the upper end of a riser that drains by gravity. Trap heel of riser to remove condensate.

Take engine connection off top of main and fit separator as close as possible to engine. Fit guides at each end of the expansion bends, anchor factory line at tee, and fit an additional expansion bend in 165-psi line supplying factory main. Keep engine lead as far as possible from prv control line.

A M PALMER *Brooklyn, N. Y.*

FLEXIBLE HOSE between engine valve-chest flange and shutoff valve beyond reducing valve would stop transmission of engine vibration to piping. This scheme, used in many different types of plants, does a good job of isolating vibration. Also, cost of the hose is low.

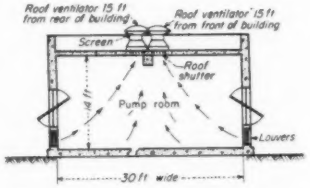
HERBERT W HEARTY
Glen Oaks, N. Y.

For your two new problems from Power readers, turn to page 138

WHAT'S BEST PUMP-ROOM VENTILATION?

HERE ARE THE FACTS: We'd like to know how much air to exhaust from our pump room to keep inside temperature below 100 F in summer. Fans high in the outside wall exhaust air. See sketch p 139, Nov *Power*. Outdoor air enters through windows and louvers.

Pump room houses three steam-turbine-driven pumps and two motor-driven standby units. Total turbine hp is 200; standby motors 50 hp. Pumping temperatures are 500 F; all pipe is insulated. Turbine and pump casings are bare. Total run of pipe in room is 200 ft. Operators pass through room once an hour, remain only long enough to take log.—*CP, Nov Power*



Here Are the Answers

CLOSE WINDOWS and block louvers in wall containing the exhaust fans. Run the fans; measure temperature of air entering and leaving the room, also amount of air passing through room. If air temperature leaving room is too high, *CP* needs more fan capacity and a larger number of louvers.

Easiest way to find amount of air flowing is to measure its velocity at the inlet louvers and multiply by louver area.

MARCELLO GIOMI
Albuquerque, N. M.

LOCATE INLETS on north end of building, if possible. Put in enough fan capacity so room has an air change every four minutes. Have inlets on wall opposite fans, close to floor.

MELVIN EVANS *Chicago, Ill.*

REMOVE WALL FANS and put in two roof ventilators fitted with fans. These will do a better job. Locate each ventilator 15 ft from end of building, near roof beam. See sketch. Size fans to give air change every four minutes.

A J BREUGELMANS *Hoboken, N. J.*

INSTALL A BLOWER and ducts to blow cool air on plant operators. Fit roof ventilators to allow hot air to exhaust to outside. If room is still too warm, insulate pump and turbine.

A M PALMER *Brooklyn, N. Y.*

FLOOD ROOF with 2 to 4 in. of water. This will help reduce room temperature and cut sun load on air in room. *CP's*

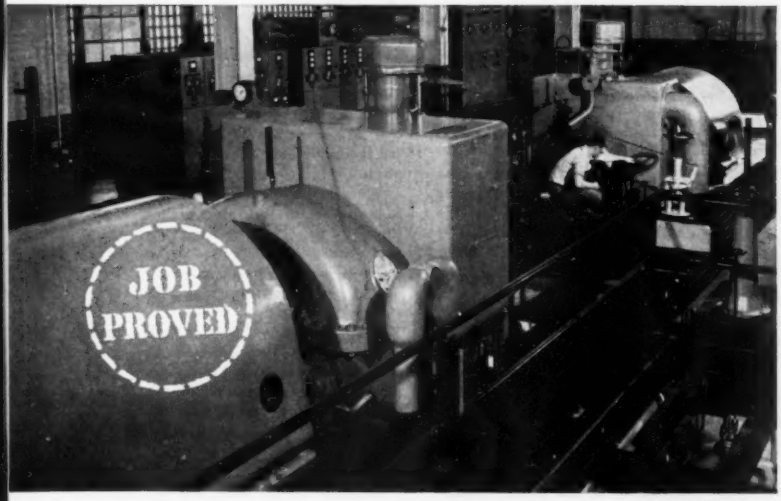
Chas. Pfizer & Co., Inc., is the discoverer and sole manufacturer of terramycin, the newest "wonder drug," which has proved effective in the treatment of *more than 50 acute infections*. Pfizer is the world's largest producer of antibiotics and a leading producer of synthetic Vitamin A.

Power—lots of it and never failing—is needed by Pfizer's modern plant at Groton, Conn., to safeguard round-the-clock production. The plant relies entirely upon its two steam turbines for power, light, and refrigeration. For the utmost protection, "Job Proved" Sunvis 916 Oil was chosen as the lubricant for these turbines when installed—two years ago. This Sunvis 916 has been in continuous service ever since. As expected, inspections show the turbines free from rust, sludge, and corrosion; and laboratory tests show the oil ready for thousands of hours of continued service.

Sunvis 900 Series Oils are unsurpassed as turbine lubricants. Under normal operating conditions they will be *good for the life of your turbines*. For complete information, telephone the Sun Office nearest to you or write Department **P-10.**

TERRAMYCIN being processed as an elixir, a new dosage form in which this "wonder drug" is more easily taken by infants and old people. The work is carried on in a sterile air-conditioned room.

POWER FOR "WONDER DRUG" PRODUCTION PROTECTED BY SUNVIS TURBINE OIL



TWO 2,500 KW TURBINES, each charged with 300 gallons of Sunvis 916 Oil, generate all of the plant's power. The condensing-extraction unit has been running over 15,000 hours, the back-pressure unit over 7,000 hours.

THE LUBRICATING OIL flows continuously through a layer of wool, then a tank of water, and finally a triple bag filter. Recent tests at Sun's laboratories show that the oil is in excellent condition, and good for thousands of hours more.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO

More PLANT PROBLEMS

Begins on Page 134

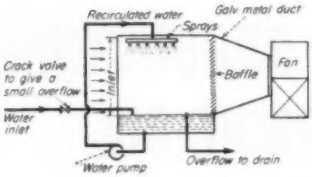
present setup allows air entering windows to short-circuit to fan without doing much cooling.

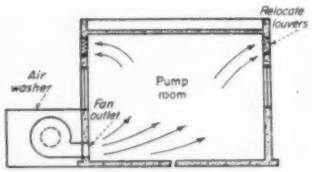
J L Aikman *Drummondville, Que.*

FIGURING HEAT LOAD I found that three fans, each rated at 1000 cfm, keep indoor temperature at 100 F or lower when outdoor air is 90 F. Propeller fans with two or four blades would do good job.

Put fans in a wall opposite that having air-inlet openings. Close windows tight and draw all air through the inlet openings. Have free area of opening at least six sq ft for each fan.

John B Prather *Yonkers, N. Y.*
William T Mullen
Philadelphia, Pa.





HIGH TEMPERATURE of outdoor air in summer makes air cooling a tough job. *CP* would be better off with the simple air-conditioning system shown in sketch.

Fan has a 7000-cfm capacity, draws air through spray chamber and discharges to pump room. Baffles prevent water from entering fan. Recirculate water, feeding it back to sprays. Relocate room louvers as in sketch.

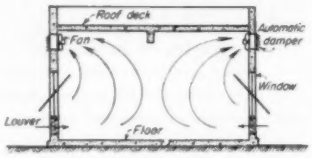
Packaged-type conditioner could also be used. Locate it so good circulation is obtained at all times.

A Crawford *Montreal, Can.*

REMOVE SOME HEAT by fitting hoods over turbines, pumps and motors. Connect a duct at the top of each hood and run it to an exhaust fan that discharges outdoors. This, with the present wall fans, may be enough to keep room temperature at right level.

Of course, it would be cheaper to insulate turbines and pumps.

Clyde G Howarter *Canton, Ill.*



FOR THESE JOBS we exhaust 15 cfm per sq ft of gross floor area. This is adequate in moderate climates. For *CP's* room this gives a little over 64 air changes per hour.

To be safe I think *CP* should install exhaust fans on both sides of the room. Size each for its share of air to be handled at ¼ in. water static pressure. Sketch shows fan and louver layout that will keep room cool enough for men.

If *CP* prefers, he can use roof ventilators fitted with propeller fans. Spot a ventilator in each bay.

Don't try to pull all the heat from this room. To do that you'll have to use fans giving 200 air changes per hour. Instead, exhaust only enough air to give livable conditions from breathing line to floor. That is all that is needed.

C P Royal *New York, N. Y.*

USE FOUR FANS, one in each corner of the building, discharging through the wall near the ceiling. Control fans with individual thermostats. Connect each fan to plenum chamber installed near ceiling. Fit plenum with suitable openings to take air from all parts of room. Install thermostats in plenum near fan. Set them to stop fan at 85 F. This will cut fan running costs.

Henry R Carr *Philadelphia, Pa.*

YOUR NEW PROBLEMS FOR FEBRUARY

1 What Turns Cooling-Tower Water Red?

We have an induced-draft redwood-filled cooling tower serving gas engines in our pumping station. Tower filling is nail-less and there is little exposed metal in water path.

Shortly after tower went into use the cooling-water color changed to dark red. We emptied system and refilled it with city water but after a few days the water turned dark red again.

All piping is galvanized; we haven't found any corrosion in pipes, flanges or engine jackets. Not only that, water color changed faster than we think it would if pipes or jackets were rusting.

We haven't started to treat our cooling water yet but we've been wondering if the color change means that treatment is needed. What makes it turn red? Is it serious? Should we drain red water? What's best treatment for water? How should chemicals be fed to the tower? Will treatment stop algae?—*CJ*

2 Should Laundry Use Condensate Return?

One of our laundries has several flat-work ironers of the steam-chest type. Steam line to laundry has a safety valve set at 100 psi. When we get 90 to 95 psi in ironer steam chests, valve pops.

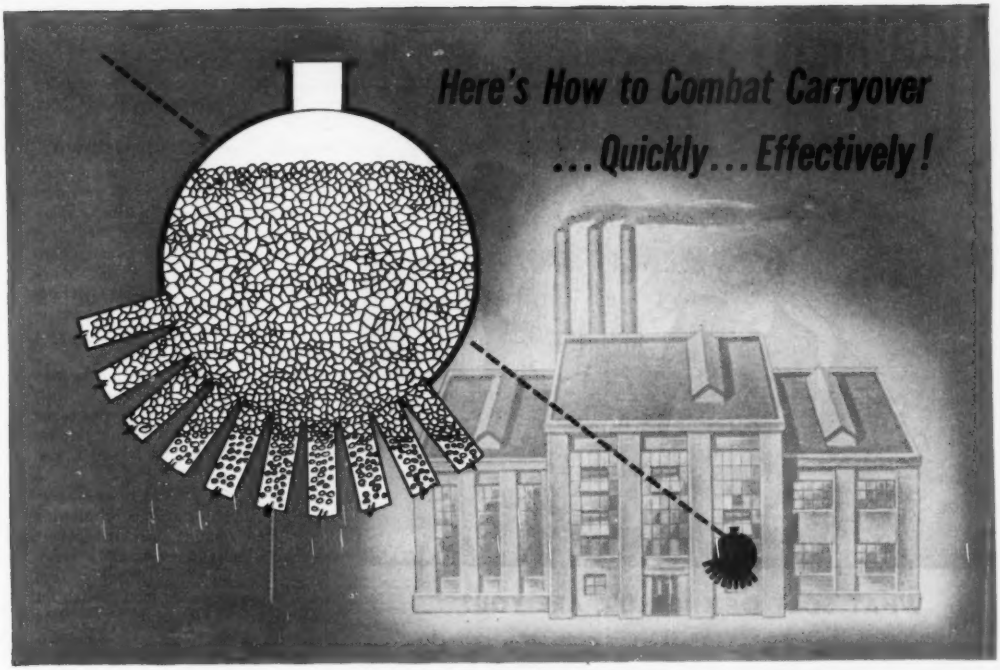
We asked the boiler inspector to allow us to set valve higher than 100 psi but he refused. We feel ironers work better at a pressure above 95 psi and wonder if we're getting best efficiency now.

Each chest has a bucket trap which seems to be working well. A friend of mine thinks our return lines or traps may not be big enough to handle load. He suggests we re-pipe entire return system and put in bigger traps.

Another friend tells me we need a return system fitted with a pump.

What's best way of doing this job? Will bigger traps give us better production? Or is a condensate-return system fitted with a pump the answer?—*EF*

Will you help readers who sent us their problems? Extra pay for photos, sketches.



One of the most common sources of trouble and expense in steam power systems is carryover and excessive blowdown. But these troublesome conditions, even when extreme, can easily be overcome by the proper application of anti-foam agents.

To illustrate the point, in one plant operating with 100% cold lime soda softened make-up water, boiler water concentrations above 7,500 ppm caused severe carryover with normal boiler water levels. With water level two inches above normal, carryover occurred at 6,500 ppm boiler water solids. It was necessary that boiler water concentrations be restricted by the maintenance of a 16 to 20% rate of blowdown.

Application of anti-foam agents to this problem permitted doubling the boiler water concentrations and reduced blowdown to the range of 8-10%. In addition, heat savings in blowdown totaled more than $30.00 per day!

In this, as in many other cases, the use of anti-foam agents permits efficient plant operation with a minimum blowdown rate.

Why not ask a Betz Engineer to tell you how anti-foam agents can save *you* time, money and effort in *your* plant? Ask him too, about the complete Betz *Specialized* Water Conditioning Service tailor-made to your needs.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Betz Technical Paper No. 115, "Carryover Prevention with Anti-Foam Agents" is free for the asking. Write today.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

—TYLER HICKS, *Associate Editor*

WHAT SORT OF ENGINEER ARE YOU?

► I STOPPED OFF for a quick beer the other day and heard an argument that made me think of Phil Swain's editorial, "What's an Engineer?"

Two fellows were debating over the area of a gable. Raising his voice, one of them shouted, "Don't hand me that line. I know what I'm talking about . . . I'm a *roofing* engineer." I had a mouthful of suds and almost choked when the other fellow shouted, "So what . . . I'm a *siding* engineer."

As if that wasn't enough, I turned on the radio while driving home and heard the announcer blast, ". . . storm windows will save you . . . write or phone now . . . will send one of our *engineers* to your home!"

How times have changed! It would probably fill a complete issue of POWER to list all the fandangle kinds of engineers around today. I'm beginning to wonder just what the word means.

Then again, perhaps the trend is all for the good. Just think! We might have the pleasure some day of being buried by a *funeral* engineer. I can see the newspaper advertisement: Will Dig-em, Burial Engineer; Coffin & Coffin, Inc, Funeral Engineers. Rest in Peace with our Golden Slide-Rule Service.

ART CANNON *Laurence Falls, N. J.*

More Meter Trouble

E A ROBERTS' GRIPE (p 144, Nov POWER) about circular-reading meters reminded me of trouble we once had in my home town. A man running a business there was billed $90 for gas. He kicked but paid it. Next month the bill was $96. He kicked again and paid it.

The gas company thought the bill was too high. They looked the meter over and found it was OK. My friend had to go right on paying the high bills.

A young fellow working as a cashier in the gas company office decided he'd look into the bills on his own. He installed a meter known to be right and found the owner had been paying bills *ten* times too high.

Instead of $90 they should have been $9. Why? Because gas meter had been set to give a reading ten times the actual amount. Of course it hadn't been done purposely. It was an accident.

J H SQUIRES *Newark, N.J.*

Shellac Gives Boiler Bugs

I AGREE WITH Art Cannon (p 144, Nov POWER) on shellac for handhole gaskets. It gave me trouble galore until I got wise and looked it up in the encyclopedia. I found that shellac comes from bugs. It's secreted by a certain insect as a resinous substance.

That explained to me why shellac spoils so easily and I've laid off it ever since. I refuse to use it.

J H SQUIRES *Newark, N.J.*

Wants Planned Blowdown

As I see things through my bifocals today, the method average operators use to reduce solids in boilers is below par. You can't expect to find true chlorides content of boiler water unless the water column is thoroughly blown clear before sample is taken. Chlorides tend to settle in petcocks and drain lines; unless you blow them clear your readings will be way off.

Seems to me it is much more sensible to sample from halfway up on drum water space, not the top or bottom of the space. Blowdown is necessary but for Pete's sake let's get rid of solids with the least possible loss.

Oil-fired plants should have burners *out* for two minutes before blowing down. Men running coal-fired boilers can take a hint and use a similar method. In most modern plants fuel feed and draft can be eased long enough for right blowdown of solids by shifting load to other units.

Don't forget that careless blowdown means wasted fuel and water. These cost money. This money goes down the drain, lost forever. Think it over next time you blow down a boiler.

A E RICHARDS *Toronto, Ont.*

Good Pump Repair

C A ARMSTRONG TELLS (p 116, Dec POWER) how he repairs cracked pump valve decks without welding. I did the same job awhile back and think I got better results.

I took a piece of steel plate about six inches square and put it over the crack. Four holes were drilled through the plate on each side of the crack. I took off plate, drilled and tapped four matching holes on one side of the crack in valve deck.

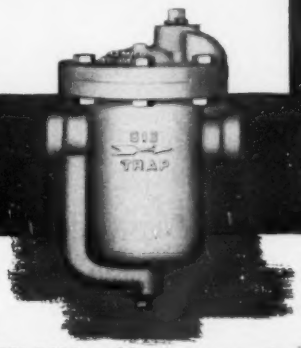
After tapping, steel plate was bolted to deck with capscrews. That left four holes on other side of plate to act as a drill jig. To pull deck together we heated plate with a blow torch until it expanded, then used the four open holes in plate as guides for spotting drill holes in valve deck. Drill same size as hole was used.

With the four holes spotted on the valve deck we removed plate, drilled and tapped the holes. Plate was bolted down again, heated until it expanded enough and capscrews tightened in place. As plate cooled it pulled crack tightly together.

GEORGE SOLVICHECK *San Francisco, Calif.*

THE EVIDENCE IS OVERWHELMING!

ARMSTRONG TRAPS GIVE UNEQUALLED RESULTS



NEED FOR NEW BOILER ELIMINATED after installing Armstrong traps on canning equipment . . . *Bestovall Canning Co., Vancouver, B. C.*

50% DECREASE IN HEAT-UP TIME of plating coils . . . *Proctor Electric Co., Philadelphia, Pa.*

15% GREATER PRODUCTION since unit trapping with Armstrongs . . . *Sun Ray Cleaners, Chicago, Ill.*

NO REPAIRS IN SIX YEARS ON 250 Armstrong traps . . . *Plymouth Shoe Co., Middleboro, Mass.*

20% FUEL SAVINGS after trapping heating coils individually . . . *Norton Greenhouses, St. Paul, Minn.*

SAVING 14 TONS COAL PER MONTH with Armstrong traps . . . *M. Wile & Company, Buffalo, N.Y.*

30% LESS MAINTENANCE on traps on low pressure heating system . . . *John Deere Harvester Works, East Moline, Ill.*

BETTER QUALITY WORK since trapping laundry equipment with Armstrongs . . . *Soft Water Laundry & Cleaners, Long Beach, Cal.*

40° HIGHER TEMPERATURES in flatwork ironer rolls . . . *Peter Bent Brigham Hospital, Boston, Mass.*

40 MINUTES FASTER HEAT-UP in drying oven since Armstrong traps were installed . . . *Emerson Drug Co., Baltimore, Md.*

DRIER HEAT-UP TIME CUT 2-3 HOURS with six Armstrong traps . . . *Industrial Grain Products, Fort Williams, Ontario.*

SAVES 3728 GALLONS FUEL OIL first year Armstrong traps were installed . . . *Mary Lincoln Candies, Buffalo, New York.*

YOU CAN confidently *expect* results like those listed at the left when you install Armstrong steam traps because:

- No steam loss, hence steam and fuel savings and less return line back pressure.
- Air is vented automatically along with condensate, assuring maximum temperature, less corrosion.
- Valve and seat are chrome steel, hardened, ground and lapped—good for temperatures to 900°F, 950 psig, they last for a long, long time at lower pressures.
- Valve lever assembly and bucket are 18-8 stainless for long wear and corrosion resistance.
- Nothing to stick, clog, leak or collapse.
- Dirt is washed right through by swirling action of the condensate.
- There is almost no friction between moving parts.
- The valve is either wide open or tight closed—no wire-drawing, no dribbling, less wear.
- Condensate is discharged at steam temperature, keeping units at top temperature.

Why have less? Order your Armstrong traps now.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

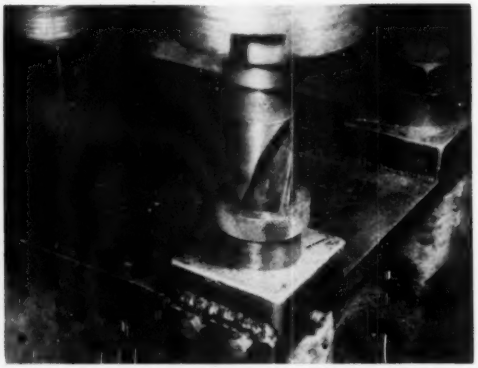
SEE OUR CATALOG IN SWEETS OR CEC

SEND FOR THE 36-PAGE STEAM TRAP BOOK FOR COMPLETE DETAILS

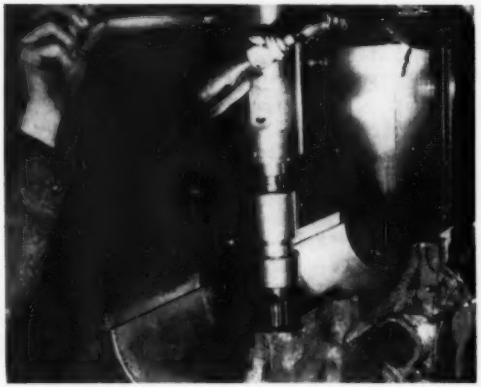
ARMSTRONG STEAM TRAPS

HOW TO RENEW WORN THREADS FAST

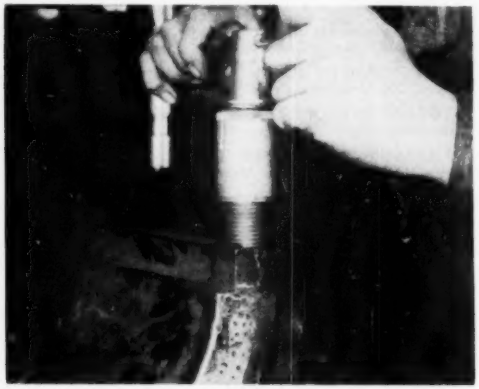
1 Threads in traction-motor base are badly worn. Base casting is positioned in a heavy-duty universal drill press



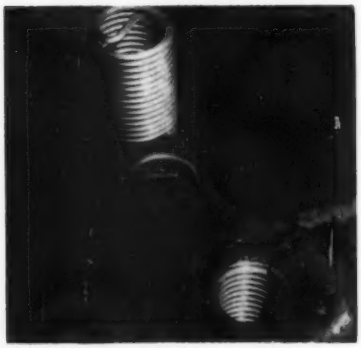
2 Drill jig in position for drilling out the worn threads. This jig is not needed for the average one-shot repair job



3 Tap hole with over-size standard-pitch threads to fit outside contour of insert. Use starting and finishing tap



4 Assemble the coil into the insert tool and screw into the tapped hole. This is an easy operation, requires no skill



5 Remove tang by giving a sharp blow with a tang break-off tool designed for this use

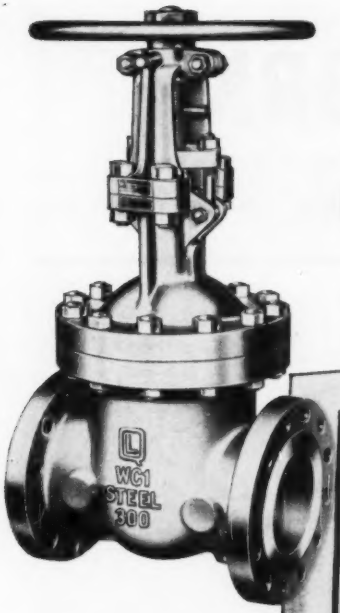
STAINLESS STEEL WIRE-METHOD

► WORN THREADS are usually built up in one of three ways: (1) over-size thread method (2) using a solid bushing, and (3) building up with welding. Now the wire-insert method shown here comes into the picture.

These precision-formed coils are made of diamond-section 18-8 steel wire. It is claimed they provide a higher thread flank surface and so they give threads higher loads.

First, drill out the old threads. Then tap oversized hole and screw in wire coil with an insert tool. That brings the thread back to the original size. Because its free diameter is slightly larger than receiving hole, insert is self-locking when in hole. But it is easily removed with another tool. This method also saves time and uses less labor and materials.

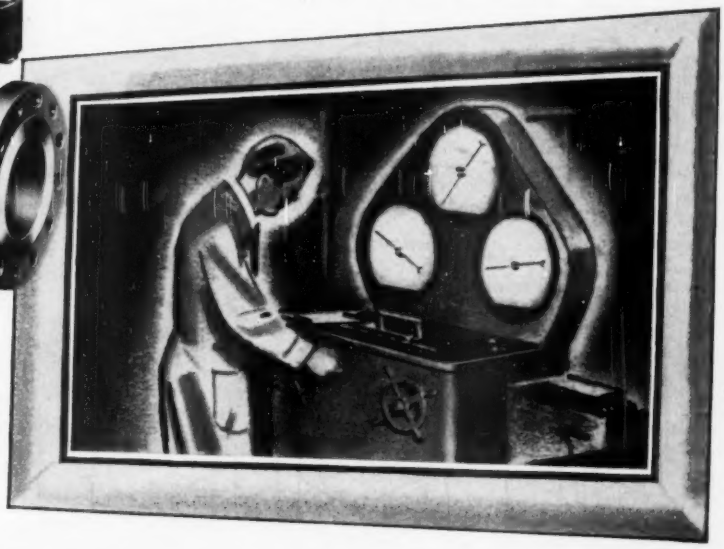
HELI-COIL CORP, *Danbury, Conn.*



Take advantage of

LUNKENHEIMER RESEARCH

IN CAST STEELS



The latest findings of Lunkenheimer's research division are available to *you*—to help solve *your* valve problems in power installations—low or high pressure, bronze, iron or steel. Lunkenheimer research in cast steels has been outstanding for more than 23 years.

Whether your service requirements are normal or severe, you will benefit from Lunkenheimer's latest research in welding, graphitization, new alloys, creep strength, and other subjects. They open up a fund of knowledge that gives you higher valve efficiency . . . safer operation . . . longer valve life.

The Lunkenheimer Sales Department will be glad to study your valve problems in the light of new research. Ask your local representative to show you the recent Lunkenheimer literature on Steel Valves, and write for further information to The Lunkenheimer Co., Box 360-A, Cincinnati 14, Ohio.

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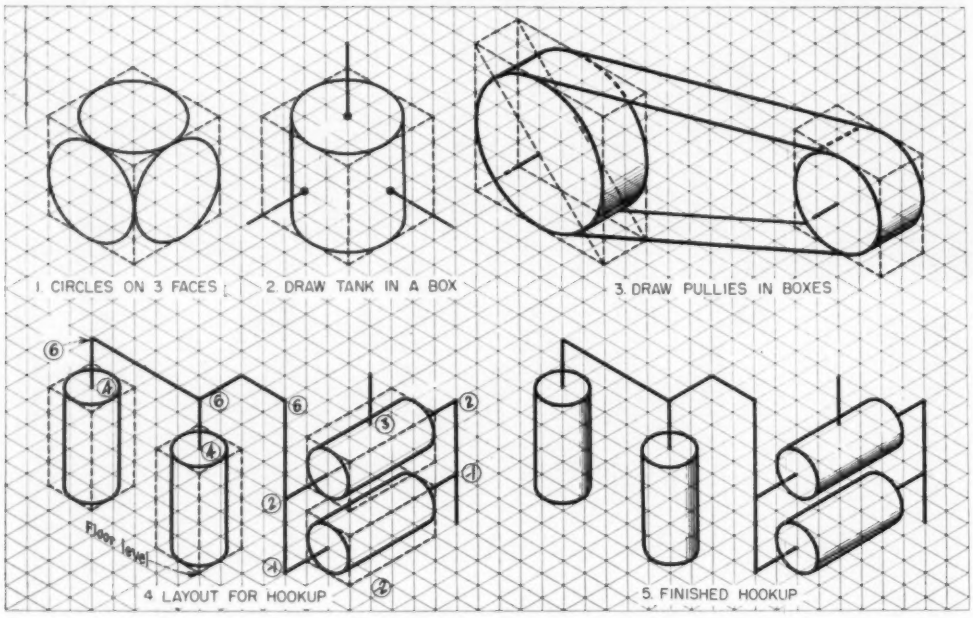
HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Isometric Sketching-5

► To WIND UP this series let's sketch some circles in isometric. Imagine a circle drawn inside a square. When you tilt the square for the isometric view, it becomes a diamond, and the circle becomes an ellipse. The circle touches the middle of each side of its square. In the same way the ellipse touches the middle of each side of its diamond.

Fig. 1 shows the three standard positions of the isometric ellipse, *facing* up, east and south. You can rough in these ellipses freehand, but a celluloid template is much easier and neater. From the smallest size ellipse up to 2-in. length use template No. 1300, sold by Keuffel & Esser Co, 127 Fulton St, New York, N. Y.

For ellipses from 2 in. up to 12 in. use ingenious C-Thru template, from firms like E H & A C Friedrichs, 40 E 43 St, New York 6, N. Y. Be sure to ask for the "35-deg isometric ellipse."

To place the ellipse correctly on isometric paper, always outline the diamond it fits into. The long axis of the ellipse must line up with the long diagonal of the diamond. Practice drawing sketches like Fig. 1.

Fig. 2 shows how to draw a round tank and center connections. First sketch a tank with square ends. Then fit the end circles (ellipses) of the round tank into the square (diamond) ends. To see where a connection will take off from the center of the top, bottom or ends, just locate the corresponding points on the square tank. They will be the same for the round tank.

Fig. 3 shows the same idea applied to a belt drive. To clean up this picture erase all construction lines—also all hidden parts of the belts and pulleys. A little freehand shading will dress up the picture.

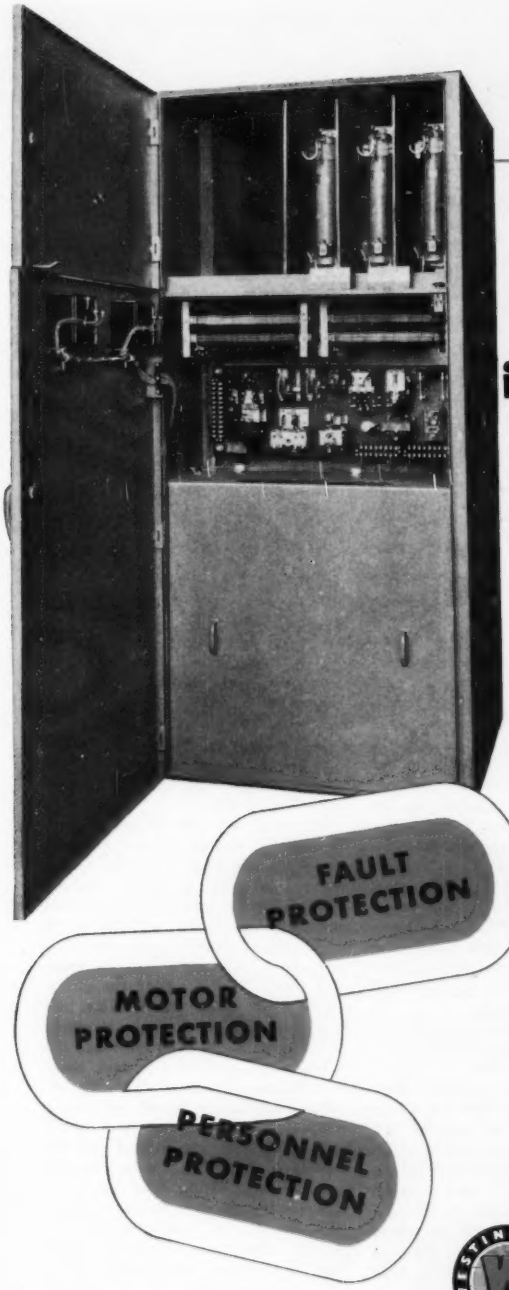
Fig. 4 shows first step in laying out a hookup of round tanks. The trick is to draw the entire hookup using square-end tanks only. Then draw the round tanks inside the square tanks.

Fig. 5 shows how Fig. 4 looks after it has been cleaned up by erasing all construction lines, adding a little shading.

To avoid trouble keep track of the elevation of each connection above the floor. Fig. 4 shows how you can indicate these elevations (in small circles) on the rough sketch. Better check the elevation shown in Fig. 4 to see how they were figured out.

This ends the isometric series. I hope you have found these articles useful in your daily work.—Phil Swain

YOU CAN BE SURE.. IF IT'S
Westinghouse



ONE WEAK LINK
in your high-voltage motor control
CAN BE COSTLY

2300-4800 voltage systems pack a punch! It takes more than just a starter for *safe* control of motors connected to these systems.

What's the answer? The three-way co-ordinated protection of Westinghouse Combination High-Voltage Starters. They combine high interrupting capacity with motor and personnel protection—in one unit. Contactors and fuses, as well as all other components, are designed for each other . . . made to work together . . . balanced for the best results.

Each link of this three-way protection is of equal importance. You get positive fault protection with type BAL fuses. Heavy-duty contactors—either oil-immersed or air-break type—guard the motor. Sectionalized cabinets offer protection for personnel.

Ask your Westinghouse salesman to give you full details and a copy of "Co-ordinated Protection", booklet B-4673. Or, write directly to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27003

Westinghouse
HIGH VOLTAGE STARTERS

"It's because I'm crazy like Mark Twain," I answered.

Haywire Engineering

► MARMADUKE SURFACEBLOW'S office is getting to be a hangout for all kinds of interesting people. Ever since his far-flung friends learned that he went into the consulting business, old shipmates and buddies keep popping in.

Yesterday I walked over to his office and there was Charley Harrison, chief engineer of the Mansfield Leland Hotel in Mansfield, Ohio. We learned that Charley Harrison has a hobby of collecting antique steam threshing engines. He now has eight of them. Charley was showing Marmy and his visitors newspaper clippings and photographs.

"These photos show how I moved my latest 20-ton iron horse all the way from Fargo, North Dakota," Charley was saying. "She's a 110-hp job and stands 13 ft wide, 22½ ft long and 14 ft high to the cab's top."

I squinted—could hardly believe my eyes. The threshing machine looked more like a young locomotive.

"I'll bet you never operated one of those monsters," I said to Marmaduke, wondering if he had.

"BILGEWATER ON THRESHING ENGINES," roared Marmy, leaning back in his swivel chair and propping up his feet on his desk. "I cut my eyeteeth on these contraptions. Why, I learned more about boilers out in the wheat fields than I did in boiler rooms."

"How come?" I asked, sitting down while the old boy wound himself up.

"Back in 1907," bellowed Marmaduke, "I signed off an Alaska steamship out in Seattle. I had been down below in engine rooms so long the ship's doctor suggested I hit the wide open spaces and soak up some sunshine. So I headed for North Dakota. Scuttlebutt had it that threshing-machine engineers were in demand as the season was just starting.

"My first job was out in the middle of a 2000-acre farm, miles from nowhere. If you think marine engineers are on their own out at sea, you haven't run a thresher in the wide open spaces.

"That threshing engine was a giant. She carried 125 psi and stood a good 12 ft high. The boiler had a straw-burning attachment. That was a horse on me, but I always said you got to operate all kinds of equipment and burn all kinds of fuel before you can call yourself a steam engineer.

"Two water boys were assigned to me. They each drove a team hauling a tank wagon. The tanks were filled from slews. In case you swivel chair engineers don't know it, slew water is snow water that lays on the ground all summer. It's highly alkali and gets a boiler to prime.

"The threshing season lasted only a couple of weeks, so I wanted to make sure that boiler and engine would keep running without a hitch. I started to give her a close inspection, but the boss was needling me to get up steam. Said he had a big gang on the payroll.

"First thing I noticed was that her try-cocks had been removed and the holes plugged. She had a gage glass but did it or the steam gage work?

"I flushed the old mud out of the boiler and filled her by unscrewing the filling plug on the shell near her stack. Then I poked a stick down to check the water against the glass. The glass didn't read correctly. I found it plugged with mud. After taking care of that, I inspected her tubes. Some were plugged with soot, so I punched all the tubes. Then I tried her safety valve to make sure it wasn't stuck.

"The boss was getting pink around the gills. He wanted to know when I'd get up steam. Said he never had an engineer who did so much 'fussing around.' Then he assigned two rawboned youngsters, one to fire and one to oil.

"We started shoveling in straw. That stuff really roars and brings up steam in a hurry. But I noticed the gage's needle didn't move although air and steam blew out of the open air cock.

"I unscrewed her gage and found the bourdon tube plugged with mud, probably because of constant priming. By soaking the tube in water and poking in haywire, I soon had her back on the boiler. This time she worked and the needle jumped to 20 psi when I opened the gage cock. By the time steam was up, the harvesting gang was raring to go.

"There were 12 bundle wagons for hauling wheat from the fields, three spike pitchers and one thresher man.

"I started the engine. A 9-in. belt ran the thresher, 80 ft away. With exhaust shooting into the sky, I kept those two water boys going to the slews and back on the double.

"That place was a madhouse. I

(*Continued on page* 214)

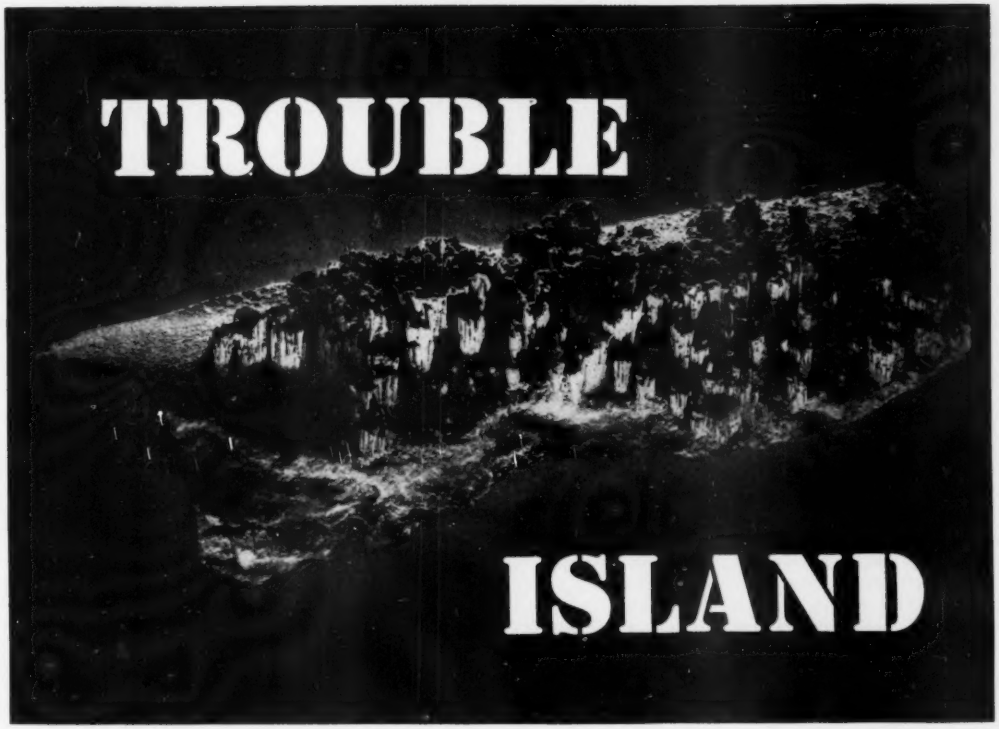


Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

Considering this a challenge, Nalco sent a Doctor of Physical Chemistry—an expert water technologist—to the refinery. His weeks of work on the spot led to basically different treatment with new chemicals which cleaned up the condenser and kept it clean. Further Nalco research and development of chemical inhibitors has since enabled cooling systems to operate without scale or corrosion *with water hardnesses as high as 200 grains per gallon.*

Point is this: neither Nalco nor anyone else had an answer to scaling in that condenser. Nalco put the necessary brains to practical use and *got results* . . . benefiting, in the long run, not only that particular refinery, but every user of cooling water.

Whether your water treatment problem is unique, or stubborn plant-run, you will get prompt, decisive action from Nalco in the direction of positive results. Write or telephone today.

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JENKINS PRACTICAL PIPING LAYOUTS 60

How to plan a

SINGLE COIL ALL-YEAR AIR CONDITIONING SYSTEM

The year-round Air Conditioning System illustrated here is one of the best of the many types available for institution, industrial, and domestic installations. It is also economical to install and maintain, since only one coil is used, with chilled water pumped through in summer and hot water in winter. Two coil systems are recommended where simultaneous zone heating and cooling is required.

In this system, the water in a closed continuous circuit is pumped through either the chiller or the heater and then to the air handling units. Either a pressure expansion tank like the one illustrated, or an open tank located at the highest point in the system should be incorporated into the system to provide for changes in water volume as the temperature of the water within the circuit changes. This prevents the buildup of unnecessarily high water pressure and minimizes loss of water through the relief valves. When the more preferable closed expansion tank is installed, the expansion or contraction of an air cushion decreases pressure changes due to water volume fluctuation.

All air supplied to the conditioned spaces is filtered to remove dust, pollen, or other particles. Also, a positive means is provided to introduce fresh air which is properly mixed with the returned air before re-use. This mixture passes over the heat transfer coil which is located in the air handling unit.

A thermostat, located in the return air duct, regulates the position of the three-way modulating valve on the individual coil which maintains the desired temperature in the conditioned space. Since the total flow to each unit is constant, any change at one unit does not affect the flow at other units. The three-way valve meters the necessary amount of water to the coil, and at the same time bypasses the balance of the constant flow around the coil.

The Jenkins Fig. 106-A Bronze Globe Valves, recommended for various control points in this system, are the Renewable Composition Disc type. They are designed to provide continuous vapor-tight closure, and can be restored to new-like operating condition by simply slipping on a holder containing a new composition disc.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

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Composition Disc
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GLOBE VALVE
150 lbs. Steam
300 lbs. O.W.G.

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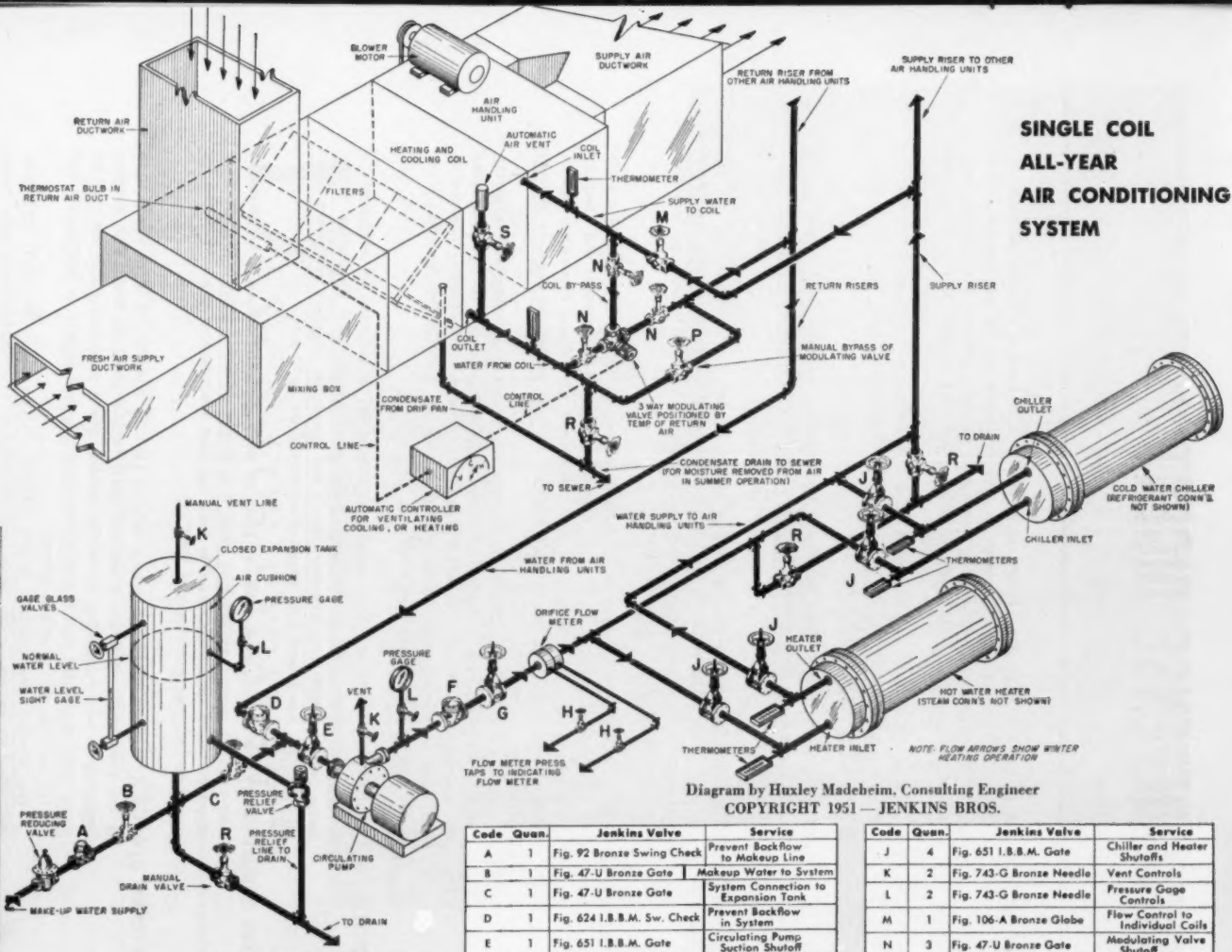

Diagram by Huxley Madeheim, Consulting Engineer

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VALVE RECOMMENDATIONS

For details of valves to suit varying conditions see Jenkins Catalog

Code	Quan.	Jenkins Valve	Service
A	1	Fig. 92 Bronze Swing Check	Prevent Backflow to Makeup Line
B	1	Fig. 47-U Bronze Gate	Makeup Water to System
C	1	Fig. 47-U Bronze Gate	System Connection to Expansion Tank
D	1	Fig. 624 I.B.B.M. Sw. Check	Prevent Backflow in System
E	1	Fig. 651 I.B.B.M. Gate	Circulating Pump Suction Shutoff
F	1	Fig. 624 I.B.B.M. Sw. Check	Prevent Backflow in System
G	1	Fig. 142 I.B.B.M. Globe	Regulate System flow
H	2	Fig. 743-G Bronze Needle	Orifice Flowmeter Tap Connections

Code	Quan.	Jenkins Valve	Service
J	4	Fig. 651 I.B.B.M. Gate	Chiller and Heater Shutoffs
K	2	Fig. 743-G Bronze Needle	Vent Controls
L	2	Fig. 743-G Bronze Needle	Pressure Gage Controls
M	1	Fig. 106-A Bronze Globe	Flow Control to Individual Coils
N	3	Fig. 47-U Bronze Gate	Modulating Valve Shutoff
P	1	Fig. 106-A Bronze Globe	Modulating Valve Manual Bypass
R	4	Fig. 106-A Bronze Globe	Drain Valves
S	1	Fig. 106-A Bronze Globe	Vent Shutoff

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Ten million kw of new capacity is scheduled for 1952, against a probable increase of about 9.5 million kw in requirements. If this expansion can be put through in the face of shortages and restrictions, we'll pick up some reserve margin after two years of losing ground. Total planned increase for 1952 through 1954 is 30 million kw.

If this job is done by the end of 1954 – and there are serious doubts that it can be – total capacity will exceed 107 million kw. This is more than twice capacity available at end of World War II.

Copper gained only slightly – both in respect to production and stocks of refined metal held by producers. The industry looks to improvement in the supply situation by late 1952.

Controlled materials for repairs of damage caused by fire, flood, storm, etc., may be obtained by utilities under an amendment to Order M-50, which allows exceeding minor-requirements quotas under certain conditions. Amended order also includes other changes, mostly of a detail nature.

Bituminous coal production went up to 535 million tons in 1951, from 512 million in 1950 and 437 million in 1949. Coal's two biggest customers – the steel and electric-power industries – each took more than 100 million tons. Major expansion in both fields should push 1952 needs much higher, but coal production capacity is more than ample.

As a matter of fact, John L. Lewis recently proposed a "nonprofit" shipping company to carry coal to Europe cheaply. While nothing much is likely to come of the scheme, it reflects his awareness of (1) the way his bargaining position is weakened by the relatively large current stockpiles, and (2) the fact that some miners are still on a short work week.

Priorities can now be used to obtain materials needed for installation of equipment in existing buildings. This is provided by an amendment to CMP Regulation 5, the basic order for MRO (maintenance, repair and operation) supplies and minor capital additions. Amendment also brings other provisions up to date.

Steel demand may be met during 1952, at least in many product lines, say industry executives. But more than anything else, this hinges on scrap supply. Unless more scrap comes in, and stocks can be built up, new steel-making capacity slated for operation this year can't be used 100%.

Defense spending will double the annual rate of 1951 by midyear. In other words, this is the year when munitions production really starts going to town. With defense beginning to take a big slice out of the national pie it seems sure that the civilian share must shrink and that the manpower squeeze, now largely on specialists and skilled workers, will grow and spread.

But election-year politics favors a fatter civilian slice. So you'll find some predicting an easing of the pace after midyear if (1) expansion in metals eases supplies (2) defense buildup seems well on the way, and (3) war with Russia looks no closer.

Engineering and construction firms seeking help in getting equipment needed to fill defense contracts should contact National Production Authority's Facilities and Construction Bureau, recently appointed claimant agency for such organizations.

DESIGN FOR EXPANSION

The unit system of construction for steam power plants is the most economical when possible future expansion is contemplated. The first three 100,000 kw units with three 7,500 kw condensing house units of Pacific Gas and Electric Company's new Steam Station at Moss Landing, California, were completed in 1950. An extension including two additional units, embodying still greater refinements for operating efficiency, was authorized almost immediately. These units will be placed in service late in 1952 and will increase the nominal capacity of the station to 522,500 kw.

The entire plant was designed and is being constructed by Stone & Webster Engineering Corporation in collaboration with the Pacific Gas and Electric Company's Engineering and Purchasing Departments.

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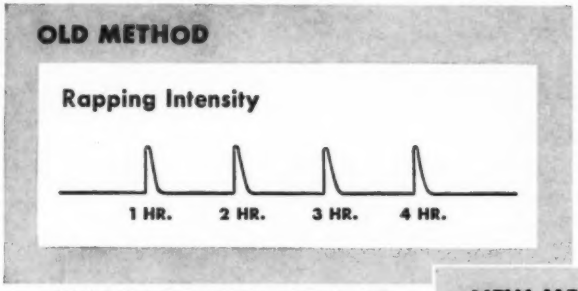
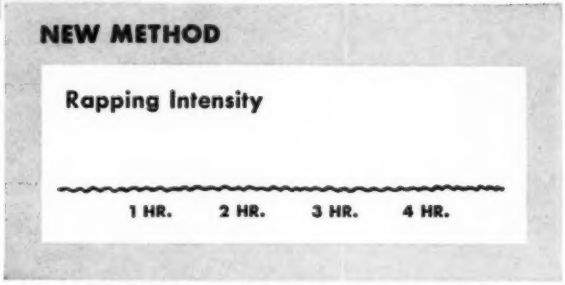
FOR ELECTRICAL PRECIPITATORS

ELIMINATES RAPPING PUFFS



Old Method of Rapping Resulting in Rapping Puff

Here are two simple diagrams that clearly demonstrate the importance of the new method of rapping developed by Research Corporation. The first shows the old way in which dust is shaken loose from electrodes at *periodic* intervals, causing intermittent puffs or clouding.



New Method of Continuous Rapping Eliminating Rapping Puffs
Rapping Intensity

This second diagram illustrates the new scientific method of cleaning electrodes. It involves continuous or sequential rapping, every minute or less, at a controlled vibrational intensity. This converts precipitation from a batch operation to a *continuous and uniform process.*

This is another major contribution by Research Corporation to the field of electrical precipitation. Constant research and development work for the past 39 years has resulted in many other improvements over the first Cottrell Precipitator. These advances plus the unequaled experience gained through over 1000 installations, listed at right, assure you of a profitable solution to your specific problem.

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293 Detarring Installations
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86 Steel Plants • 114 Oil Refineries
and Miscellaneous Installations

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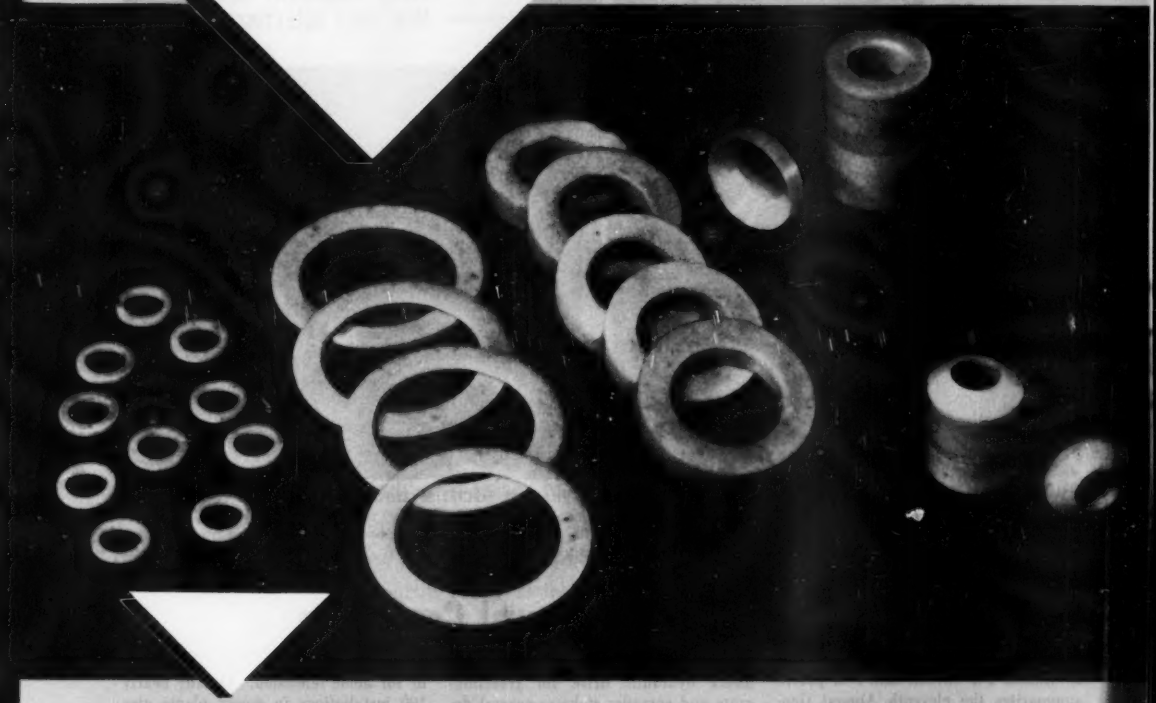

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READER SERVICE SECTION

POWER NEWS 152
TECHNICAL BRIEFS 154
PLANT EQUIPMENT NEWS 158
NEW FREE BULLETINS 167

POWER SHOW: Dr. Otto Holden, assistant general manager, engineering, Hydro Electric Power Commission of Ontario, cuts the ribbon opening Canada's Power Show while gen secy W G Childs (left) and president Charles E Baker (center) look on

AFFILIATED SOCIETIES LUNCHEON: F S G Williams, Taylor Forge & Pipe Works (center) talks with Prof E A Allcut, University of Toronto (left) and Emmett Briceland, vice president, Institute of Power Engineers. Williams spoke at the luncheon

IPE Holds Eleventh Annual Convention

► BIGGER AND BETTER than ever before summarizes the eleventh Annual General Meeting of the Institute of Power Engineers. For 4 days, Nov 26 to 29, the Hotel Royal York was host to the meeting and Canada's Power Show that over 4000 attended. Activities continued from morning to late evening. These included 8 technical sessions, 3 luncheon meetings and 3 banquets.

The Power Show, opened by Institute Dominion President Charles E Baker, was the largest ever held in Canada. It had over 50 exhibits representing more than 150 manufacturers, and displayed a wide range of power plant equipment. Included were several designs of boilers, oil burners, smoke-density indicators and recorders, automatic combustion controls, indicating and recording meters, pumps, feedwater-heating, treating and associated equipment, valves, traps, refractories, and heat insulation, motors and their controls.

Among the larger pieces exhibited were a 300-hp diesel engine; a cross section through the drum of one of Canada's largest high-pressure, high-temperature boilers installed in the Toronto and Windsor plants of the Hydro Electric Power Commission of Ontario; a direct hydraulic drive for traveling-grate and spreader stokers; several designs of stokers, coal pulverizers, flyash and cinder eliminators.

Wired Television. One of the most interesting exhibits was the Utiliscope or wired television. A camera was installed on a pulverized coal-fired furnace of a boiler in the railway-station heating plant. The camera was wired by coaxial cable to a viewer 2000 ft away in an exhibit at the Power Show. All during the Show operation of the furnace was on display.

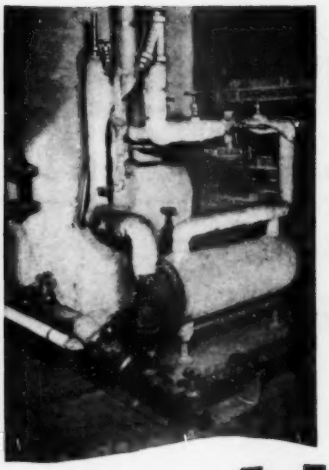
This equipment was featured in a paper by G H Wilson, electronics div, Diamond Power Specialty Corp, at the Wednesday evening technical session. Wilson pointed out the simplicity of wired television—to get a picture from studio camera to home receiver requires 750 to 1000 tubes and many technicians to keep the equipment operating properly. Wired television has total of only 17 tubes and operates continuously without attention. Viewer has a cold cathode tube dissector with a guaranteed life of 9000 hr compared to 250 to 500 hr for home television. Already nearly 100 installations in power plants give operators a control-board view of furnace operation, water level, and smokestack discharge. Outside the power plant, wired television is serving important applications in steel and other industries.

For **Coming Events** turn to page 208

Hydro Power. At the opening technical session, Dr Otto Holden, asst gen mgr of Ontario's Hydro Electric Power Commission speaking for Robert H Sanders, chairman of the commission, summarized the power situation in Ontario as it is today. He said that when the commission started delivering power in 1910 its system had a peak load of 8043 hp, where this year it will be over 4,000,000 hp. Since 1945 the commission has installed 1,319,200 hp and by 1956 nearly 3,000,000 hp will have been added. The load in Southern Ontario is increasing at a rate of 15% or nearly 500,000 hp per year. This rapid increase in load has made it necessary to build two large steam plants, one in Toronto and one in Windsor, and is the reason why the commission is so vitally concerned in the St. Lawrence development of hydroelectric power.

(*Continued on page* 206)

Sarco type TR-30 regulator with needle valve supplies just the right amount of steam to the oil preheater to maintain correct oil temperature at the burner, regardless of load changes or intermittent operation. Efficient burner operation is assured, resulting in a saving in fuel.



Sarco type 24-30 Temperature Regulator is pilot-operated and single seated for tight shut off when no water is drawn. The thermostat in the water discharge from the heater responds instantly to load changes and holds the water temperature constant — Never too hot or too cold.

indispensable

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In the industrial steam plant of moderate size, elaborate instrumentation usually is out of reach. However, there are two very common applications for which temperature control really is indispensable; namely, fuel oil preheating, and hot water service. Sarco can do the job with inexpensive

Self-Operated Temperature Regulators

which will pay for themselves in a few months — often a few weeks.

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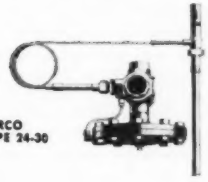
Thousands of installations, as the examples shown, in every part of the country, testify to Sarco dependability. You set them and forget them. Temperatures are always right.

Sarco can solve your control problem within your budget



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TECHNICAL BRIEFS

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17 Digests for you on:

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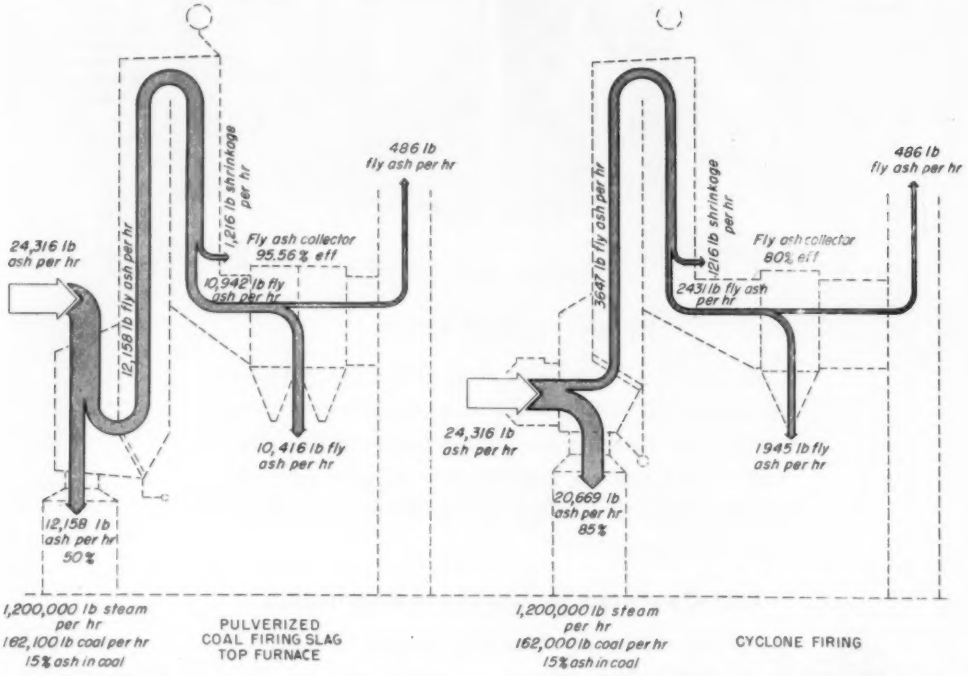
24,316 lb ash per hr
12,158 lb fly ash per hr
1,216 lb shrinkage per hr
Fly ash collector 95.56% eff
10,942 lb fly ash per hr
486 lb fly ash per hr
10,416 lb fly ash per hr
12,158 lb ash per hr 50%
1,200,000 lb steam per hr
162,000 lb coal per hr
15% ash in coal
PULVERIZED COAL FIRING SLAG TOP FURNACE
3647 lb fly ash per hr
1216 lb shrinkage per hr
Fly ash collector 80% eff
2431 lb fly ash per hr
486 lb fly ash per hr
24,316 lb ash per hr
20,669 lb ash per hr 85%
1945 lb fly ash per hr
1,200,000 lb steam per hr
162,000 lb coal per hr
15% ash in coal
CYCLONE FIRING

Early predictions based on the first cyclone burner to go into service back in 1946 indicated a distinct reduction in the quantity of flyash leaving the furnace. Illustration, above, based on 5 years' experience, with 33 units, bears out the claim

Cyclone Burner

Station Design with Cyclone - Fired Steam Generators. *By H C Schroeder and R J Strasser, Sargent & Lundy Co.*

At the December 1946 ASME meeting, A E Grunert, L Skog and L S Wilkinson outlined the early development and operating experience with a cyclone-fired steam generator. They listed the aims, advantages and savings hoped for with this new firing method.

The present paper brings design experiences up to date and, combined with a comparison paper *Operating Experiences with Cyclone-Fired Steam Generators*, by V L Stone and I L Wade, gives a very frank discussion of the cyclone burner.

Many of the highly specialized engineering features required are brought out by illustration and table. For example, Fig 1 above shows why a pulverized coal plant needs a larger dust collector than a cyclone unit for the same size furnace. The authors also indicate savings in reduced building requirements.

Further they discuss some of the problems this design has produced and the hopes for their solution. *ASME paper. No. 51-A-118.*

Operating Experiences with Cyclone-Fired Steam Generators. *By V L Stone, Commonwealth Edison Co and I L Wade, Public Service Co of Northern Illinois.*

Along with the paper above the authors have presented as frank a report on a new coal-firing method as anyone could want. The avowed purpose was to examine the hoped-for advantages expressed in 1946 in the light of some 5 years' experience and 33 operating units. The report is required reading in fuel engineering.

When later cyclone units went into operation, plant personnel knew that the multiple-burner design was more complicated and expected a need for greater operating skills. Higher steam temperatures and a bin system for firing further complicated operation.

The authors divide the problems into 8 major headings—control, operating procedures and characteristics, experience with various fuels, maintenance, dust emission, evaporation efficiency, boiler cleanliness, operating difficulties.

Some of the major conclusions are: (1) flyash leaving the furnace is defi-

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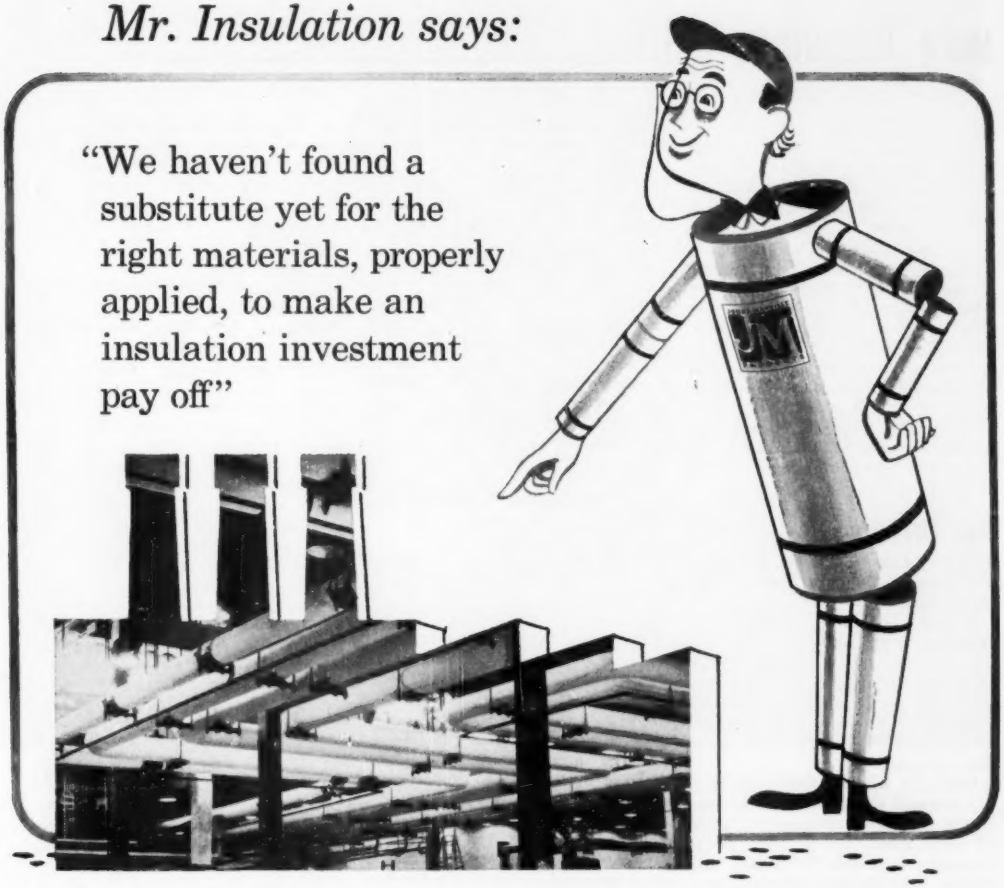

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Johns-Manville *first in* **INSULATIONS**

More TECHNICAL BRIEFS

Begins on page 154

nitely reduced (2) maintenance of burner and coal preparation equipment is very low (3) relatively large coal size permits economical use of a bin firing system, greatly simplifying operations (4) boiler efficiency holds up to design expectations (5) cyclone furnaces work well on natural gas or oil (6) power costs for coal preparation go down but forced-draft fan power costs rise more than enough to offset coal-crusher savings (7) cyclone furnaces do not decrease fouling of heat absorbing surfaces when burning Central Illinois coal.

These authors also express confidence that the problems of cyclone-firing can and will be solved. *ASME paper. No. 51-A-119.*

Gas Turbine

Operating Experiences with Stationary Gas Turbines. *By Paul R Sidler, Brown Boveri Corp.*

A review of experiences built up in operating 13 gas turbine units around the world. Most of the difficulties can be charged off to growing pains. Once the causes are clearly established the author feels proper remedies will be adopted and the troubles will never show up again.

Difficulties are those from items like: (1) damaged refractory liners in combustion chambers (eliminated by using all metal liners) (2) soot fires in recuperators (controlled by making soot blowers a standard installation item) (3) corrosion in intercoolers along with hard deposits on axial compressor bladings (eliminated by design changes in the intercoolers).

Primary cause for the third difficulty was exhaust gas entering the air ducts; careful plant layout considering prevailing wind direction plus filters at the air inlet ducts will solve this problem successfully in most instances.

Breakage of axial compressor blades, a fourth difficulty, came from self-induced vibrations removed forever by damping wires. The last major difficulty, cracks in turbine rotors and blades, was solved by basic design changes.

Problems arising from ash in heavy fuel oils are a separate class, the author says. He suggests building gas turbines with maximum operating temperature 1100-1200 F to avoid this difficulty. Exact fuel oil compositions giving the least troubles are tallied. *ASME paper. No. 51-A-104.*

Review of Optimum Design of Gas Turbine Regenerators. *By D Aronson, Greensburg, Pa.*

Summarizes design relationships as a means of simplifying design and selection of most suitable regenerator for a particular gas turbine application. Criteria are presented for shape, volume, weight or surface area; whichever is the principal limitation. Further, the distinctive features of bare tube design and extended surface are outlined.

Several equations let you approximate relationships for heat transfer arrangements differing from the ones covered by the author. *ASME paper. No. 51-A-107.*

Design Features of a 5000-HP Gas Turbine. *By B O Buckland, and D C Berkey, General Electric Co.*

A 5000-hp, 1-compressor, 2-turbine gas turbine power plant is described; its features discussed; its expected capability and economy given.

The plant, designed to have a maximum of flexibility in its application, is intermediate in efficiency and complication between a simple 1-compressor, 1-turbine nonregenerative power plant and a 2-compressor, 2-turbine intercooled and regenerative power plant designed by the author's company.

Axial flow compressor has 14 stages and operates at a pressure ratio of 5.5. Turbine has 2 stages. The second stage produces the useful work and has a nozzle arranged so that its effective flow area can be varied during operation. The 6 combustion chambers are expected to operate at 800 F preheat and at 650 F rise. The cylindrically shaped regenerator when used mounts on end and outdoors. Lube oil system is similar to that used for steam turbines. Plant can be supplied with either a motor-driven or a turbine-driven cranking assembly. The means for starting and stopping the plant and for controlling turbine speeds and temperatures during operation are described. Weights, outline dimensions and water requirements for installation are given. *ASME paper. No 51-A-113.*

Calculation of Reheat Factors for Turbines and Compressors. *By Joseph Kaye and K R Wadleigh, Massachusetts Institute of Technology.*

A simple method for rapid, yet accurate calculations of reheat factors for adiabatic turbines and compressors with an infinite number of stages. Method is limited to fluids obeying the equation $pv = RT$ and having specific heat a function of temperature only.

The method is based upon the concept of (1) step efficiency—the efficiency of an infinitesimal stage based on reversible adiabatic work (2) the concept of the relative pressure function. This method produces charts of reheat factors for turbines and compressors employing any of several gases.

The authors give a theoretical justification for empirical rules of thumb formerly applied to predict reheat factors for turbines and compressors with a finite number of stages. *ASME paper. No. 51-A-2.*

Design and Performance of an Extended Surface Gas Turbine Regenerator. *By Sven Holm and Ray Lyerly, Air Preheater Corp.*

Describes a new type of extended surface heat exchanger developed for a gas turbine plant for a natural gas pipeline pumping station. This regenerator features compactness and low weight. Particular unit described is not as compact and light as could be made, because primary consideration was given to material strength and service life. This involved relatively heavy sections for both primary and extended surfaces. Smaller scale component parts would give higher heat transfer coefficients and increase the heating surface per unit volume by as much as 3 to 1. *ASME paper. No. 51-A-106.*

Gas Turbine's Contribution to Gas Pipeline Pumping. *By T J Putz, Westinghouse Electric Corp.*

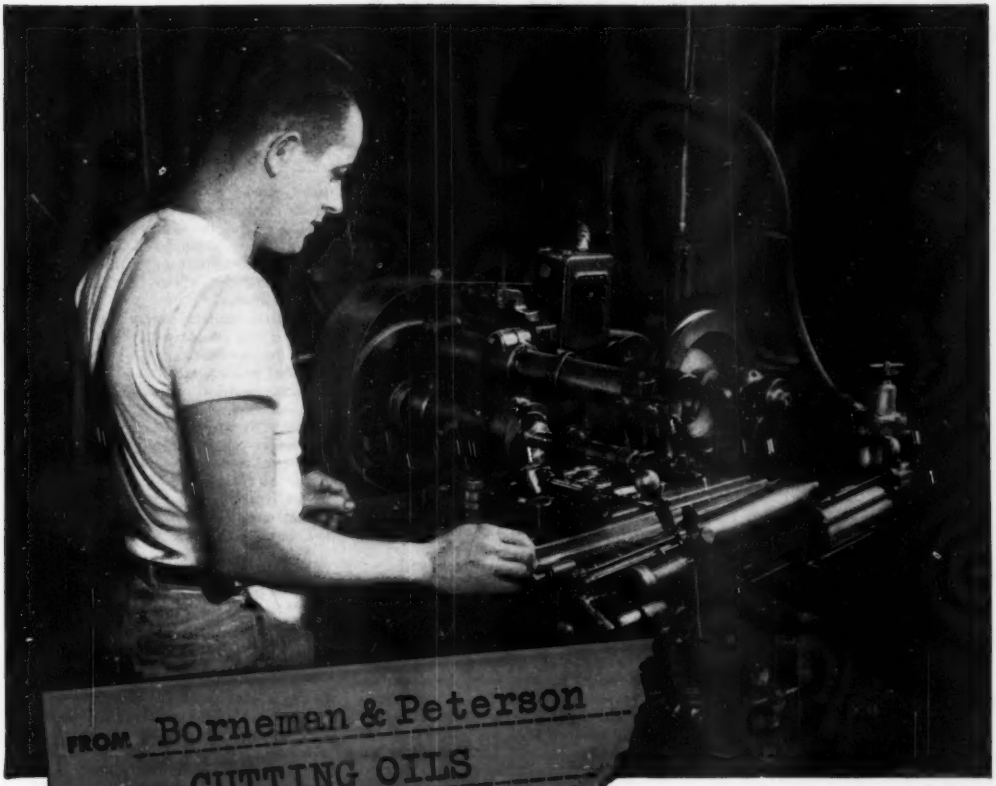
Development of long, large gas transmission pipelines to carry natural gas from field to market have made this fuel an important factor in supplying U. S. energy requirements. Present length

(*Continued on page* 192)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following source unless otherwise stated. Order complete paper from source not POWER.

American Society of Mechanical Engineers, annual meeting, Haddon Hall, Atlantic City, N. J. Nov 26-29, 1951. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.



ANY tiny production improvement looks big when it can be multiplied by acres of machines. But even without that—in an average size screw machine products shop like Borneman & Peterson's at Flint, Michigan—the improvement effected with Cities Service cutting oil registered impressively.

"We were getting fair results," write Borneman & Peterson, "before ever talking it over with a Cities Service Lubrication Engineer."

But they did talk it over, and then tried out his recommendation on a regular job of cutting ½" x 1" slots in tough tool steel. At once, the use of Cities Service Chillo cutting oil notably improved product quality.

So..."We then tried using Chillo 10 on our threading machines, and found that not only do we get a better thread, but we have increased chaser life approximately 25%."

From there on, still more uses have kept turning up in this shop for Cities Service cutting oil, simply because it distinctly pays off...as it always does when a Cities Service Lubrication Engineer offers pinpointed lubricating recommendations. He draws on the c-o-m-p-l-e-t-e Cities Service industrial line, and on deep, wide experience. You can draw on *him* by writing CITIES SERVICE OIL COMPANY, Dept. B22, Sixty Wall Tower, New York City 5.

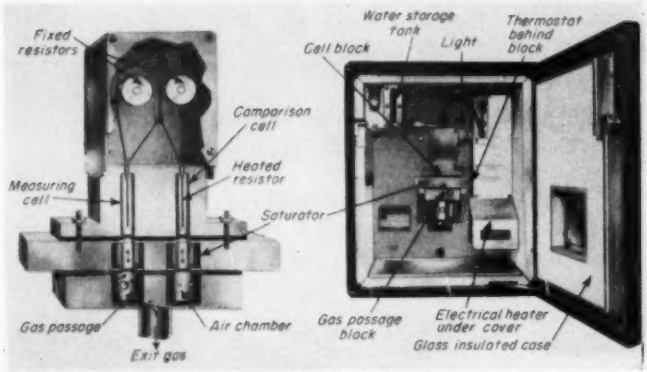
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



CO_2 RECORDER FEATURES 5 SECOND RESPONSE

P242 • *Condu-Therm* recorder was designed to meet the high standards of speed and accuracy of large industrial power plants and central stations. Instrument utilizes three established ideas:

1. The use of CO_2 measurement as a guide to combustion efficiency. This principle, that each gas has a distinct ability to conduct heat, has been used in thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is burned.

2. The thermal conductivity principle of gas analysis. This has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proven reliability.

3. Electronic type operation. This frees the instrument of the step action and delicate construction commonly found in galvanometer-operated instruments. It also adds greater speed, power and magnification, while assuring high accuracy and permanency of calibration.

Operation. Gas to be analyzed flows through passage from which portion diffuses through saturator. Here it is saturated to a constant water vapor dilution at 130 F and flows into measuring cell. There it cools heated resistor in proportion to its thermal conductivity. Heat removed from the resistor changes its electrical resistance.

Similarly saturated, air diffuses from air chamber into comparison cell. It, too, conducts heat away from heated resistor proportional to its thermal conductivity, thus changing electrical resistance. This is used as a constant reference.

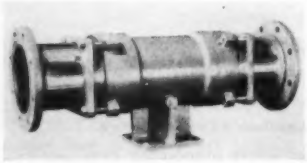
Change in resistance of comparison cell resistor is compared with change in resistance of measuring cell resistor in bridge circuit of analyzer. Bridge circuit is connected into network of recorder where resultant resistance measurement is amplified, indicated and recorded.

Features. Because of (1) rapid change of sample gas in the gas passage system, (2) small volume of gas in the analyzing cell, (3) continuous connection (through the amplifier) *Condu-Therm* CO_2 recorder gets a 5 sec response between the analyzer and the recording pen motor.

Not a laboratory instrument, the *Condu-Therm* is constructed for boiler plant use. It features (1) linkage of ⅛ x ½-in. bar (2) multiple pen bearing of telescoping stainless steel tubes (3) Oilite bearings which do not require lubrication (4) a chart plate of ¼-in. permanent mold casting (5) unit construction for easy replacement of each main element.

Full information in Bulletin 51-1008.

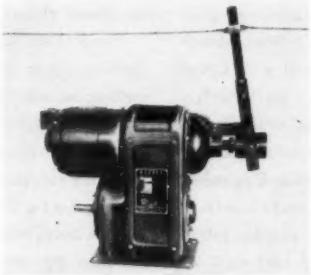
The Hays Corp, Michigan City, Ind.



SLIP-TYPE EXPANSION JOINT P218

These internally-guided slip-type expansion joints are made with both single and double joints in 150- and 300-lb steel in sizes from 3 to 20 in. Bases optional in single joints, standard in double joints. Ends beveled for welding and service connections can be supplied in all sizes and types. Standard slips have 4 in. traverse but 8 and 12 can be furnished.

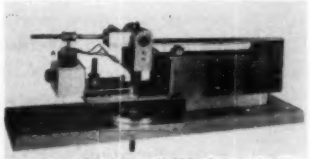
The Royalton Co, Inc, Gasport, N. Y.



MECHANICALLY CONTROLLED VARIABLE SPEED DRIVE P225

Mechanical automatic control on Reeves Series 1000 fractional hp *Vari-Speed Motodrives*. Formerly only handwheel and electric remote controls were offered in this series. These units are manufactured in ¼, 1/3, ½ and ¾ hp sizes, with speed variations as high as 10 to 1.

Reeves Pulley Co, Columbus, Ind.



CANTILEVER LOAD CELL P227

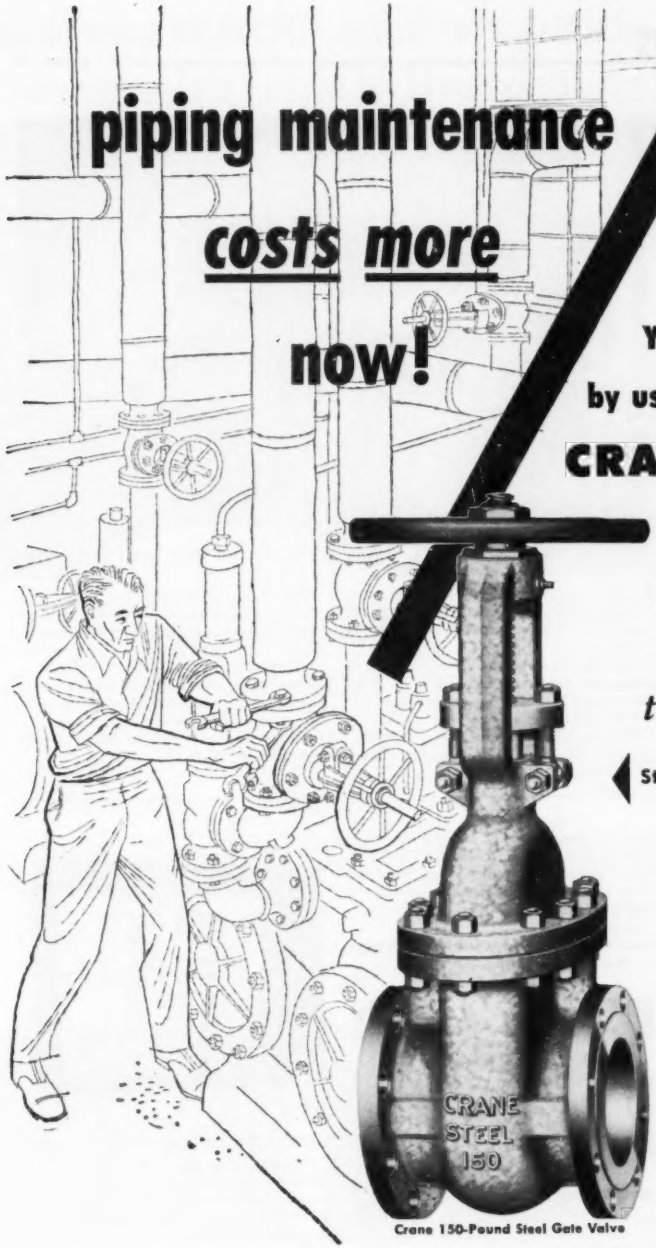
This instrument changes a mechanical force into a proportionate electrical signal that is transmitted to an indicator or recorder for evaluation. Load cell operates on the simple cantilever beam principle. One end of the beam is fixed and force to be measured is applied to the free end of lever.

Beam motion moves armature in linear transducer and an electrical signal is generated. Successfully applied to testing machine applications, the beams have a maximum stress of less than 30,000 psi. Up to four cells may be connected mechanically to a single platform, for scale applications with cells electrically connected together in

(*Continued on page* 160)

For more data on these items, use post cards, p 167. Identify request with P and number.

piping maintenance *costs more* now!



Crane 150-Pound Steel Gate Valve

You spend less for it by using Dependable Quality

CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Steel valves that stay on the job

You can practically forget valve maintenance worries with Crane Cast Steel Wedge Gates. They're unusually rugged . . . amply reinforced at all stress points. Disc is precision-guided to reduce seating surface wear. Straight-through ports give smooth flow, with minimum turbulence and erosion.

Stuffing box depth and design assure tight stem seal . . . long packing life. Valves available in trim materials for steam, water, gas, oil, and oil vapor services.

Ask your Crane Representative about the better quality and greater dependability of Crane valves—your assurance of on-the-job performance that spells lower final cost.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

series so that forces are added electrically.

Many unusual industrial weighing applications, such as elimination of complicated mechanical supports for hoppers, vats, etc, are possible. Unit available in standard ranges from 5 to 500 lbs.

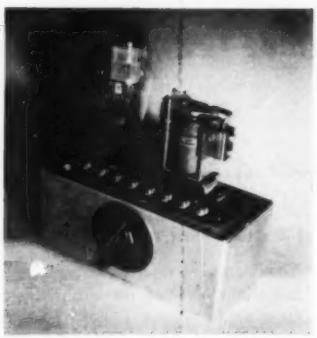
Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa.

REFLECTOR LAMP P226

Two 500-w type R-40 reflector lamps, one a flood beam the other a spot, are made of heat-resistant glass. Faces are 5-in. in diameter; lamps have mogul screw bases.

Lamps were designed to simplify maintenance and provide a high light output for applications in outdoor industrial areas. The new lamps are higher wattage companions of the 300-w R-40 reflector lamps.

Lamp News Bureau, General Electric Co, Nela Park, Cleveland 12, Ohio



ELECTRONIC TIMER P240

Time integral is continuously adjustable and accuracy is unaffected by supply voltage fluctuations. Cycle is initiated by a contact closure and SPDT relay is operated at end of the timed interval. From .05 to 20 sec intervals can be furnished. SPDT relay contacts are rated at 115 v, 5 amp, non-inductive.

Model 701 electronic timer operates on 105-130 v, 50-60 cycles. Device recycles instantaneously. Unit is 6 in. long, 3 in. wide, 6 in. high, and can easily be panel or surface mounted.

Timetrol Co, P O Box 193, Rockford, Ill.

STEAM TURBINE P210

Type H steam turbine features double extended shaft coming through governor, fast-acting hand speed-changing device, spark-proof emergency trip, and convenient vertical hand-valve position. Unit has easily removed governor valve seat and steam strainer, large capacity bearing oil reservoirs (approximately 6 qt capacity) with large fin-tube oil coolers and magnetic drain plugs. Centerline support and heavy shaft construction provide smooth operation and long life.

Murray Iron Wks, 1106 Washington St, Burlington, Iowa

For more data on these items, use post cards, p 167. Identify request with P and number.

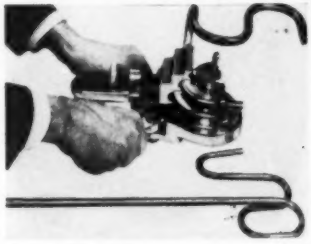
MOVING-COIL RESISTANCE THERMOMETERS HANDLE –100 TO +300F

P 211 • New line of resistance thermometers provide accurate indication and control of temperatures from –100 to +300 F.

Instruments apply in a wide variety of industrial processes. Available in three basic types for flush or surface mounting: HP-11 resistance-thermometer indicator; HP-13 two-position controller or protector; and the HP-14 three-position controller.

All thermometers use the same basic mechanism, a crossed-coil moving element and a high-strength 3¼-lb alnico V magnet, designed for hard use and reliable operation. Entire mechanism is enclosed in dust-tight, moisture-resistant case-and-cover assembly that permits service in moist or contaminated atmospheres.

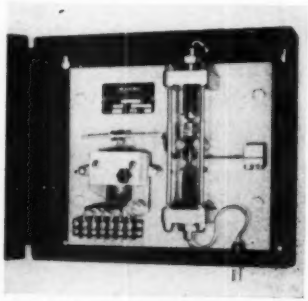
General Electric Co, 1 River Road, Schenectady 5, N. Y.



TUBE BENDER P221

This tube bender is hand-operated and makes offsets and bends up to 180 deg in ⅜, ½ and ⅝ in. OD K and L copper tubing, brass, Bundy weld, steel and other light-gage tubing. Model 1200 has no loose parts, combines all three sizes in the one tool. Bender is handy for refrigeration, radiant-heating and other bending jobs.

Tal Bender, Inc, Milwaukee 2, Wis.

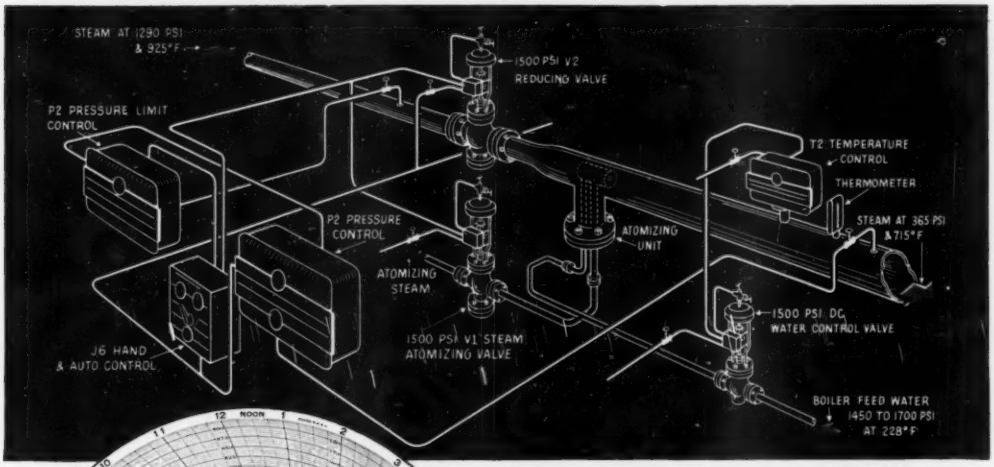


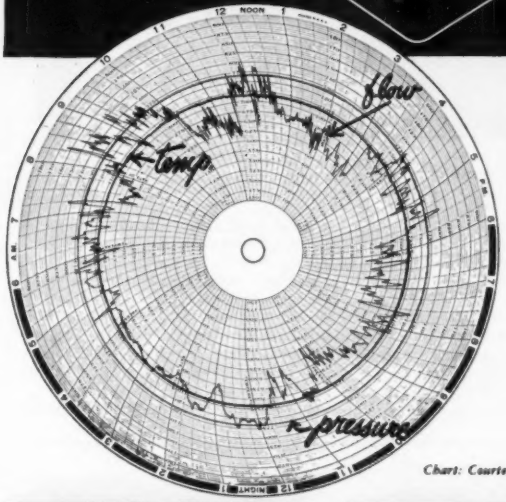
PRESSURE TRANSMITTER P228

Atcotran Transmitter measures vacuum pressures with reference to an absolute pressure. An electro-mechanical instrument, it consists of two opposing bellows connected to a cantilever beam spring and a differential transformer. Transformer requires as little as 1/100 gram for displacement of its armature to provide an ac output signal linear within 1/10 of 1%. One bellows is connected to the system to be measured while the other is the absolute pressure reference.

When negative pressure is applied to the bellows, pressure is exerted on the cantilever beam which actuates the differential

Swartwout RDC* controls within ±1 psi and ±3°F even with widely fluctuating load swings


STEAM AT 1290 PSI & 925°F
1500 PSI V2 REDUCING VALVE
P2 PRESSURE LIMIT CONTROL
T2 TEMPERATURE CONTROL
THERMOMETER
P2 PRESSURE CONTROL
ATOMIZING UNIT
STEAM AT 365 PSI & 715°F
ATOMIZING STEAM
1500 PSI DC WATER CONTROL VALVE
J6 HAND & AUTO CONTROL
1500 PSI V1 STEAM ATOMIZING VALVE
BOILER FEED WATER 1450 TO 1700 PSI AT 228°F

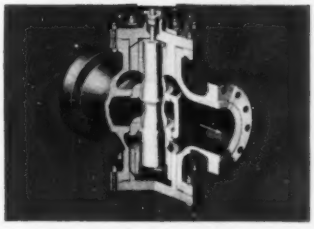


1 Chart shows how Swartwout RDC*—Reducing, Desuperheating and Control System—handles low-pressure turbine load of 65,000 to 165,000 lbs. steam per hour in Des Moines Power Station No. 2 of the Iowa Power and Light Company. It reduces from 1290 to 365 psi and desuperheats from 925° to 715°F. When main reducing valve closes, extremely light loads can be handled by pressure reducing valve supplying atomizing steam. Operation of the system is stable regardless of load change or time lag. Because of the exceptional control obtained by this large station, the Iowa Power and Light Company later purchased an additional small Swartwout RDC unit to supply steam to house turbines.

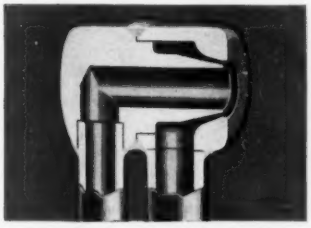
Swartwout

POWER PLANT EQUIPMENT

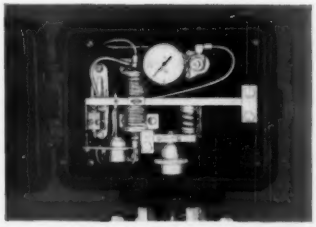
Chart: Courtesy Iowa Power and Light Company



2 Swartwout V-2 Regulating Valve has smooth, nozzle-shaped passages which guide expansion of high-pressure steam to reduced pressure zone without high-velocity impingement or other destructive forces common to conventional valves. Undue noise, turbulence and vibration are eliminated; longer valve life results.



3 Swartwout Steam Atomizing Desuperheater, constructed of stainless steel, has accurately machined passages that give narrow-angle dispersion of cooling water outside of steam atomizing head. There is no impingement of steam or water against walls of unit, no erosion of parts, no need for pipe liners.



4 Swartwout T-2 Control, with metallic temperature element in steam pipe, gives rapid and precise control regardless of magnitude of load or time lag. There are no flapper valves, relays or other delicate elements. Only two simple adjustments are involved; one for temperature, one for response.

A-6002

SEND FOR BULLETINS S-21-E, S-22-C, S-198 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

Begins on page 158

transformer armature. As the pressure varies the armature position varies and a signal is generated that is directly proportional to the spring deflection and the absolute pressure on the bellows assembly. Available in 5 standard ranges between 0-50 millimeters of mercury and 0-30 in. of mercury.

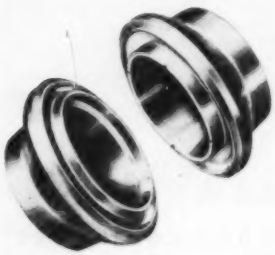
Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadlephia 44, Pa.

WIRE ROPE LUBRICANT P243

Because of its unusual penetration and adhesion properties, Texaco *Crater A* permits application to wet wire rope. This new formulation achieves greatly improved wettability while retaining all the desirable characteristics of previous Texaco *Crater A*.

Field tests on cables in use on dredges and cranes indicate that the compound is especially valuable for use in severe weather conditions. Also where the wire rope is wet when the lubricant is applied, or where cable is subjected to abnormal water conditions in use. It is a thin liquid product which is applied without heating.

The Texas Co, 135 E 42nd St, New York, N. Y.



WELDING COUPLING P216

Tube-Turn SF scale-free welding coupling eliminates damaging welding scale from piping systems. It consists of two forged halves with hub ends ready for welding to pipe or fittings of corresponding sizes. When coupling halves are brought together tongue of one slips into groove of the other. Circumferential cavity beneath beveled welding area prevents burn-through or formation of icicles in interior. Cavity also insulates interior from extreme welding heat and prevents scaling. Other advantages include easy reuse, lower pressure drop, leakproof joint as strong as the pipe, possibility of lower fabrication cost and positive reduction of maintenance. Coupling is made in sizes from 1¼ through 12 in. for a large number of fluids. Available in carbon steel, stainless steel, aluminum and other metals and alloys.

Tube Turns, Inc, Louisville 1, Ky.

For more data on these items, use post cards, p 167. Identify request with P and number.

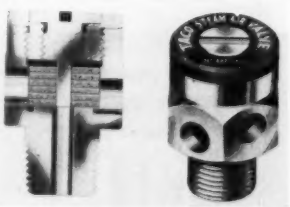
REMOVABLE METAL-CLAD SWITCHGEAR FOR 2.4- TO 13.8-KV

P235 • This standard switchgear line ranges in ratings from 150 to 500 mva, 2.4- to 13.8-kv. Units are completely pre-engineered for most commonly met kinds of power applications.

This line features design improvements in the magne-blast breaker. Here a maximum number of parts are interchangeable among breakers of different ratings. For example solenoid mechanisms and many contact and arc-extinguishing parts are identical in all ratings. Another feature is an electro-mechanical control device built integral with the breaker mechanism.

Improved insulating material has good flame-retardant, dielectric and anti-hygroscopic properties. This means damage will be localized if abnormal conditions such as lightning surges from inadequately protected lines, short-circuit duty in excess of rating or mechanical damage occur.

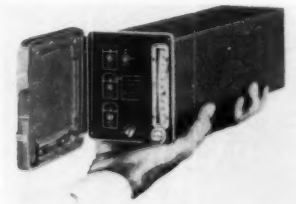
General Electric Co, Schenectady, N. Y.



HEATING-SYSTEM AIR VALVE P219

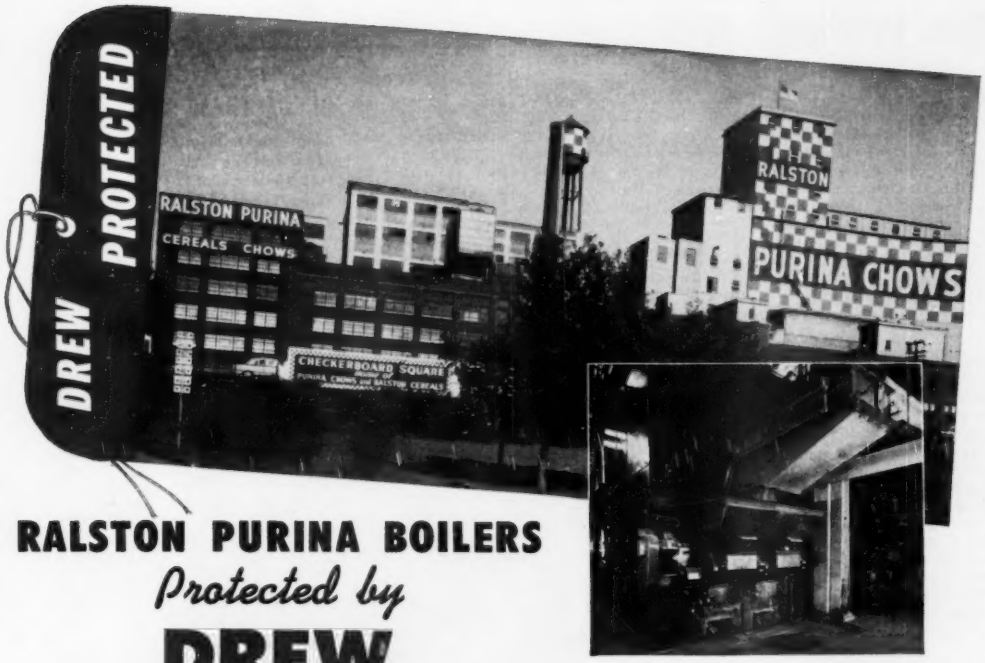
Measuring only ¾ x 1 in. this steam heating system air valve doesn't have small ports to clog, is quiet, inconspicuous, can be manually operated, is made in one size for all applications, can be installed in any position except upside down, and vents freely. Special composition disks permit air flow, stop steam.

Taco Heaters, Inc, 137 South St, Providence 3, R. I.



PROCESS CONTROL UNIT P230

Miniature all-electronic process control unit, the *Autronic Controller*, for use in chemical and food processing plants, refineries, petrochemical installations, central stations and industrial power plants. Completely electronic, unit has no moving parts, slide wires or boosters to initiate control action. Information throughout the system is transmitted by electrical means only, hence response is almost instantaneous;



RALSTON PURINA BOILERS
Protected by
DREW
COMPLETE BOILER WATER TREATMENT

Send for your illustrated DREW ORGANICS folder describing the use of organics in modern boiler water treatment. Write today.

POWER DREW CHEMICALS

This landmark on Checkerboard Square in St. Louis is the home office and original plant of Ralston Purina . . . famous Purina Chows and Ralston Cereals. A by-word in millions of homes and farms, Ralston Purina now operates 38 Chow plants across the United States.

Modern boiler water treatment plays an important role in this plant. Pure steam is essential for food processing and Drew complete BWT has protected the boilers for 5 years against steam contamination and other boiler water difficulties.

Many companies, like Ralston Purina, rely on the Drew 3-point program for better power plant operation.

1. Drew engineers make thorough studies of boiler plant operations and water conditions.
2. Drew water chemists and engineers analyze this data in Drew Laboratories and make specific recommendations for treatment.
3. Drew engineers make frequent tests in the plant to assure efficient performance of the water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

DREW PRODUCTS

Nationwide Service in Boiler Water and Cooling Water Conditioning

there are no connecting air lines between units to cause transmission lags.

Unit is of the plug-in type making it interchangeable. Entire unit is quickly unplugged by releasing a lock. There is no need to disconnect any wiring when removing or replacing the controller. One standard control can serve as a replacement for any other controller regardless of the variable being controlled or whether the control is reverse or direct-acting.

The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio

MULTI-PURPOSE GREASE P244

For use in general industrial applications, Texaco *Multifak 2* Grease is recommended for use in situations which require one high-grade multi-purpose grease for a variety of operations. *Multifak* has excellent shear stability, outstanding resistance against water washing, and good pumpability at low temperatures.

It is highly suitable for bearing lubrication over a wide range of temperatures and can be used efficiently for an extensive variety of industrial lubrication jobs.

The Texas Co, 135 E 42nd St, New York, N. Y.

SIGHT-FLOW INDICATOR P213

Trin-Vue sight-flow indicator permits checking fluid flow and visual examination of fluids in pipes. Two windows are used. Each is sealed with O-ring gaskets and *Truarc* retaining rings. Seal is good for both pressure and vacuum service. Of welded construction, unit is available in a number of stainless steels, alloys, nickel, monel and rubber-lined steel. Sizes range from ½ to 4 in., pressure ratings from 50 to 350 psi with Pyrex to higher values with Herculite. Pyrex windows standard, Herculite or Quartz on order.

Trinity Equipment Corp, 472 Westfield Ave, E, Roselle Park, N. J.

For more data on these items, use post cards, p 167. Identify request with P and number.

FABRIC TUBING P212

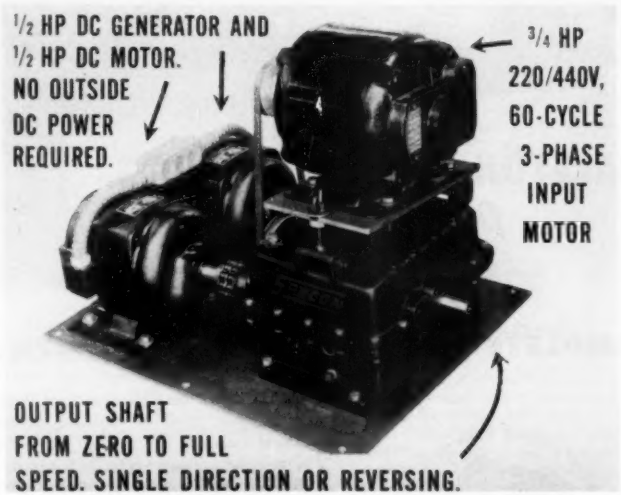
Vinyl plastic coating to give good abrasion resistance for rough handling, plus inertness to chemicals and oils are features of *Spiratube* flexible fabric tubing.

Basic patented construction principle consists of preformed, continuous, spring wire ribbing, overlapped with spirally-wound woven fabric of several alternate types.

B F Goodrich Chemical Co, 324 Rose Bldg, Cleveland 15, Ohio

CHECK THESE TOO!....

Automatic Lubricator, sight-feed ... p 172
Electrical Tape, plastic ... p 172
Dust Collector for 25-cycle service ... p 174
Motor Control Center, prewired ... p 174
Cation Exchangers, experimental ... p 176
Motor Control, outdoor ... p 178
Pumps, stainless steel ... p 180
Gas Alarm, indoor or outdoor use ... p 180
Pressure-Gage Shutoff, automatic ... p 182

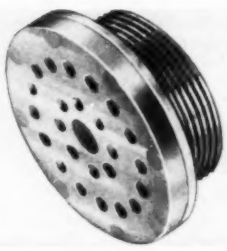

½ HP DC GENERATOR AND ½ HP DC MOTOR. NO OUTSIDE DC POWER REQUIRED.
¾ HP 220/440V, 60-CYCLE 3-PHASE INPUT MOTOR
OUTPUT SHAFT FROM ZERO TO FULL SPEED. SINGLE DIRECTION OR REVERSING.

VARIABLE SPEED DRIVE USES MOTOR-GENERATOR COMBINATION

P223 • Rated at ½ hp in non-reversing (reversible if desired) and 1/3 hp in reversing model, the *Specon* No. 00ED drive uses a motor generator combination. Unit consists of standard ac squirrel cage motor, 2 standard dc motors and a differential gear box. Ac motor is coupled with 2 dc motors through the differential gear box. Dc motors are connected in a closed loop and require no outside source of power.

Maximum output speed of non-reversing model is 250 to 1000 rpm for direct coupling. Minimum output speed in all cases is zero although motors continue to run. Maximum torque is obtained at zero speed with gradual decrease as output speed increases. At rated speed, torque assumes the rated value.

Speed Control Corp, 1450 E 289 St, Wickliffe, Ohio



SUCTION VALVE P214

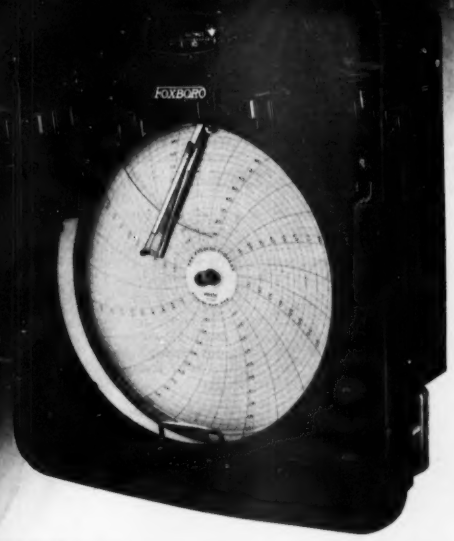
Garland suction valve is plate-type for use in ammonia machines. Moving parts weigh 1/16th as much as those in poppet valve formerly used. Valve has same port area with about half the lift. Ring-plate valve often increases capacity of compressor. Assembly, designed so no loose parts can get into cylinder, is interchangeable with former poppet valves in Frick vertical enclosed ammonia compressors.

Frick Co, Waynesboro, Pa.

(*Continued on page* 172)

better measurement and control of

FLOW



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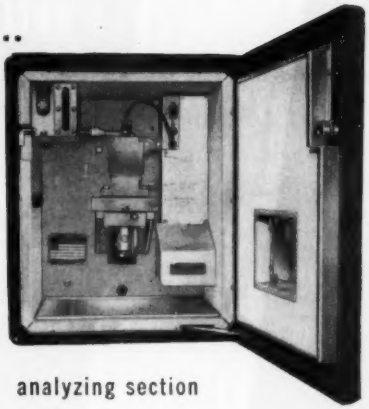
a new CO_2 RECORDER using three established ideas



analyzing section

Designed to handle the CO_2 measurement problems of large industrial power plants and central stations the new *Hays Condu-Therm CO_2 Recorder* uses three established ideas:

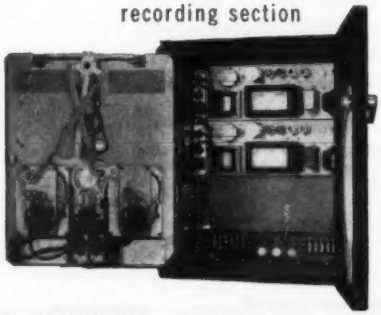
1. *The use of CO_2 measurement as a guide to combustion efficiency* . . . has been used by thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is being burned.

2. *The thermal conductivity principle of gas analysis* . . . has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proven reliability.

3. *Electronic type operation* . . . frees the instrument of the step action and delicate construction commonly found in galvanometer operated instruments . . . also adds greater speed, power and magnification, while assuring high accuracy and permanency of calibration.

features five second response with ±.25% accuracy

recording section



the condu-therm features:

5 second response to CO_2 change due to:

rapid change of sample gas in gas passage system

small volume of gas in analyzing cell

continuous connection (through amplifier) between analyzer and recording pen motor

- ***±.25% accuracy for chart ranges up to 0 to 20% due to:***

slide wire construction . . . 5 tolerances held to .1%

recording pen cam precision-machined to .0001 in.

high power gain (2.5 million)

- ***"Boiler plant" construction unavailable in any other instrument:***

linkage of ⅛" x ½" bar

multiple pen bearing of telescoping stainless steel tubes

oilite bearings do not require lubrication

chart plate of ¼ in. permanent mold casting

unit construction for easy replacement of each main element

For full information on the Hays Condu-Therm CO_2 Recorder write for Bulletin 51-1008 which includes:

detailed explanation of operation of analyzing and recording sections

completely illustrated discussion of component parts and features

drawings of and information on gas sampling systems.

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CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

AS A SOURCE OF IMPORTANT SAVINGS

Today cost pressure keeps demanding new ways to save money. You can get at the root of this situation in your boiler room.

Whether you have one or a battery of boilers you'll find your boiler room can deliver good savings through Correct Fuel Feed — Fuel-Air Ratio, and Over-Fire Draft.

You accomplish this with CASH STANDARD Automatic Combustion Control Systems. What you actually get is more steam from your present boiler—less fuel, coal-oil-gas used—savings in maintenance. CASH STANDARD units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type make no difference.

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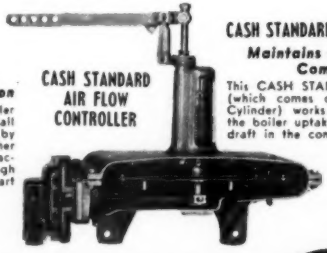
BULLETIN 300

It shows applications—tells how the system works—gives you a good insight into the savings possible.

CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

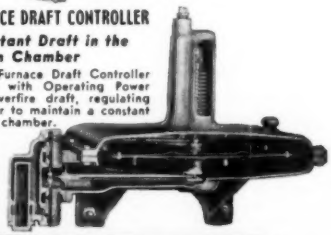
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



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B2 **AIR HEATERS** — Portable and built-in models for comfort heating. Convection, blower, duct and radiant types. 4-page folder F-1530, photos, specifications. Edwin L Wiegand Co, 7731 Thomas Blvd, Pittsburgh 8, Pa.

B3 **UNIT HEATERS**—*Torrideer* blower type. 100,000 to 1,500,000 btu, for heating large spaces. Mount on floor, wall, or ceiling. 56-page catalog DS-327-A gives specifications, outlet arrangement, mixing and intake boxes, steam or hot water capacities. The Trane Co, La Crosse, Wis.

B4 **PRODUCTS BULLETIN**—36-page condensed catalog PB-290 of the full line of Trane air conditioning, heating, ventilating and heat transfer equipment. Trane Co, La Crosse, Wis.

BOILERS AND AUXILIARIES

B5 **STEAM GENERATORS**—Package units. 250, 525, and 825 psi. 10,000 to 30,000 lb/hr. 20-page catalog PG-51-2 gives dimensions, diagrams, control systems. Foster Wheeler Corp, 165 Broadway, New York 6, N. Y.

B6 **BURNERS**—*Hev-E* gas and combination gas and oil units, allow quick change from one fuel to the other. 4-page bulletin AD-101 presents features and advantages of 5 models. Photos, capacities. Cleaver-Brooks Co, Hev-E Oil Burner Div, 326 E Keefe Ave, Milwaukee 12, Wis.

★ **GAS SCRUBBERS** — For product recovery, gas purification. 6-page bulletin 203-B gives uses, operation, construction, capacities. ★ Write direct on company letterhead to Peabody Engineering Corp, 540 Fifth Ave, New York 19, N. Y.

B7 **DRAFT REGULATION** — Engineering research bulletin shows effect of draft on gas fired boilers with burner input 400,000 btu per hr and over. Graphs, characteristics of barometric draft control. Dept 168, Field Control Div, Mondota, Ill.

ELECTRICAL EQUIPMENT

B8 **LIMIT SWITCHES** — Rotating, lever and track types. 8 bulletins,

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More FREE BULLETINS

Begins on page 167

GEA-5704, -5705, -5707 give uses, operating features, dimensions, ratings. General Electric Co, Schenectady 5, N. Y.

B9 **MOTOR CONTROL CENTER** — NEMA size 1 through 5 starter units for ac motors up to 200 hp. 24-page bulletin GEA-4979A gives features, components, specifications, selection charts. General Electric Co, Schenectady 5, N. Y.

B10 **SWITCH AND OUTLET BOX** — Wall chart gives catalog nos., sizes, no. and sizes of conductors permitted in each box. Publication 18-81. General Electric Co, Bridgeport 2, Conn.

B11 **RESISTORS AND CONTROLS**—Standard stock items. Controls, switches, line-voltage regulators, rheostats, resistors, etc. Catalog 51. Clarostat Mfg Co, Inc, Dover, N.H.

B12 **SERVO AMPLIFIERS** — Miniature, hermetically-sealed, plug-in electronic amplifiers to control 400-cycle, 3-phase servo motors. Specifications, applications, connection diagrams. Two 4-page bulletins describe models SA104H and SA112H. Servomechanisms, Inc, Post & Stewart Aves, Westbury, N. Y.

B13 **TESTING AND MEASURING EQUIPMENT** — For laboratory and production line use. 80-page catalog GEC-1016 gives reference summary of complete line. Photos, diagrams, specifications and prices. General Electric Co, Schenectady 5, N. Y.

B14 **LOAD RELAY** — Mercury plunger type. 2-page bulletin No. 860 shows control hookup for air-raid siren. H-B Instrument Co, 2633 Trenton Ave, Philadelphia 25, Pa.

HEAT EXCHANGERS

B15 **HOT WATER GENERATOR** — Constant outlet temperature. 4 to 438 gpm. 8-page bulletin 22 gives capacities, steam requirements, specifications, operation and construction. Aerco Corp, Englewood, N. J.

MAINTENANCE AND SAFETY EQUIPMENT

B16 **CYLINDERS** — For control and heavy moving operations. 4-page bulletin 152 gives applications in several fields. Ledeen Mfg Co, 1600 S San Pedro St, Los Angeles 15, Calif.

B17 **OIL AND GREASE SEALS**—For bearings. 100-page catalog 10 illustrates all types of *Kloswrap*, gives typical applications and complete list of sizes and part nos. Garlock Packing Co, Palmyra, N.Y.

B18 **STANDARD TAPS** — Designed specifically for the material they will be used on: steel and other tough materials; cast iron; light metals; die cast metals; brass; plastics. 36-page booklet gives comprehensive catalog listing. Detroit Tap and Tool Co, 415 Blvd Bldg, Detroit 2, Mich.

B19 **ELECTRONIC CONTOUR FOLLOWER**—For machining irregularly shaped parts. 1-, 2-, and 3-dimension tracer control systems. 4-page bulletin GEA-5660 has photos, diagrams. General Electric Co, Schenectady 5, N. Y.

B20 **METAL FORMING MACHINE** —Bends, folds, shapes and duplicates intricate or simple metal components. 6-page catalog No. 15 gives specifications, capacity, standard attachments. Kilham Engineering Inc, 1412 Packard Bldg, Philadelphia 2, Pa.

B21 **HARDFACING RODS** — Selection guide chart gives recommended type, size, method of application; description of *Amsco* rods. 4-page folder SG. American Manganese Steel Div, American Brake Shoe Co, Chicago Heights, Ill.

B22 **SMALL ENGINE MAINTENANCE**—Cartoon presentation of maintenance facts for small Caterpillar diesel, marine and electric equipment. Cooling, lubricating, air intake, exhaust and fuel systems. 28-page booklet 30246. Caterpillar Tractor Co, Peoria, Ill.

B23 **SERVICE TOOLS** — For caterpillar tractors. Hand and hydraulically operated tools, with attachments and accessories, for use with *OTC power-twin* hydraulic puller. 16-page bulletin CT-52. Owatonna Tool Co, N 378 Cedar St, Owatonna, Minn.

B24 **TUBE EXPANDERS** — Rolling and flaring type for superheaters and water tube boilers, 8-page bulletin No. 68. Adjustable type for tubes in heat transfer units, 4-page Bulletin No. 71. Specifications, ordering guides, photos, prices. Gustav Wiedeke Co, Dayton 1, Ohio.

B25 **VAPOR COLLECTORS**—Extract vapor from air around wet machining operations, return cleaned air to working space. Bulletin 622 gives illustrations, performance ratings, dimensions, motor size, list prices. Aget-Detroit Co, Ann Arbor, Mich.

B26 **INDUCTION HEATING** — Case histories on use of induction heating to increase production, reduce space, cut costs. 12-page booklet B-4782. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B27 **ELECTRONIC STETHOSCOPE** —For locating and diagnosing mechanical troubles. *Elec-Detec* is portable noise detector. 4-page brochure gives use, specifications. Anco Instrument Div, American Name Plate Mfg Co, 4254 W Arthington St, Chicago 24, Ill.

B28 **RUST PREVENTIVE COMPOUNDS**—Chart 1151 lists govt specifications for preservative oils and coatings, and matching *Nox-Rust* products. Gives applications, properties. Nox-Rust Chemical Corp, 2429 S Halsted St, Chicago 8, Ill.

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B31 **ANTI-RUST PAINT** — 2-page bulletin 136-11 gives uses and applications of *Rust-Cure* method. No surface preparation required. Monroe Co, Inc, 10703 Quebec Ave, Cleveland 6, Ohio.

MATERIALS HANDLING

B32 **CONVEYOR BELT** — Heavy-duty *Ray-Man F* type. For use where there is danger of tearing or puncture, where more flexibility or thick narrow belts are required. Bulletin 6915. Raybestos-Manhattan, Inc, Manhattan Rubber Div, Passaic, N.J.

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B34 **INDUSTRIAL TRUCKS**—4-page condensed catalog illustrates and describes complete line of battery powered industrial trucks. 1000 to 110,000 lb capacities. Automatic Transportation Co, 149 W 87th St, Chicago 20, Ill.

★ **FORK-LIFT TRUCKS**—32-page booklet No. SP-10, *What Makes it*

(*Continued on page 244*)

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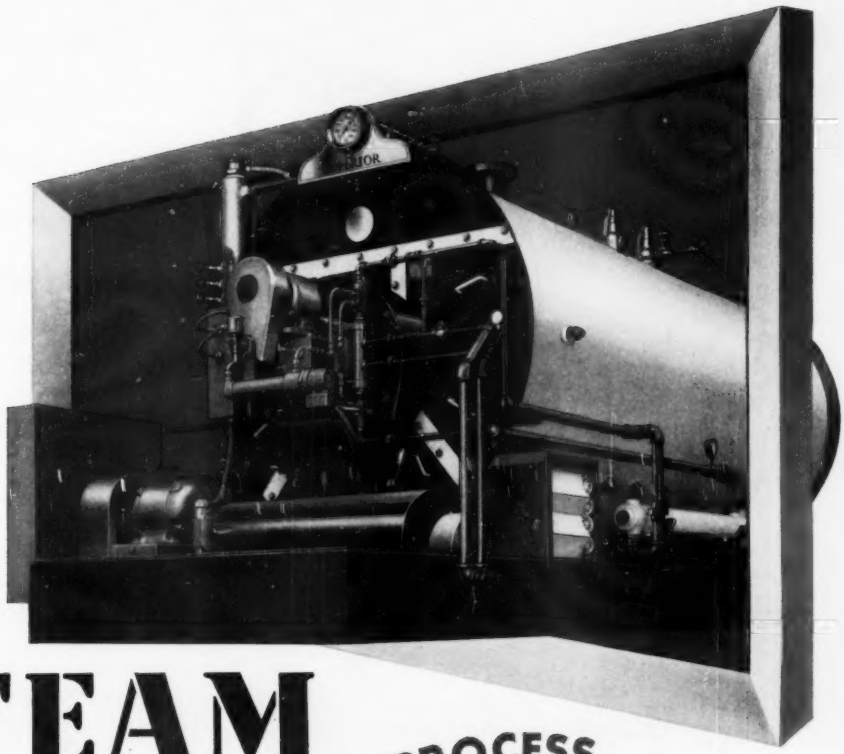

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HOW WOULD YOU LIKE TO TRADE PLACES with one of these engineers? A consulting engineer, a heating contractor and a chief engineer of a large Midwestern institution were sued for a half million dollars. Why? The heating boiler exploded, killing and severely injuring numerous people, besides heavily damaging the building. It's claimed that the boiler, designed for 50 psi, had its safety valve set for 139 psi.

GUILT is a mighty awful thing to face, especially when YOU are thought to be the cause of killing or maiming people—people like your family and mine.

Now every pressure vessel is a potential bomb—and every plant has them in one form or another. That means that all of us in plants, at home, at work or in schools are sitting near a bomb. Only reason it doesn't go off and send us to kingdom come is because it's under control. Also, that you or someone else installed it properly, keep checking its safety gadgets and KNOW its exact condition.

But I knew one good citizen—like you and me—who woke up one morning to find himself accused of negligence that caused a horrible catastrophe.

How can that happen to YOU? Easily. Because modern equipment seems to run itself and doesn't need the constant attention older plants did, you get careless. Then . . . B-A-N-G !

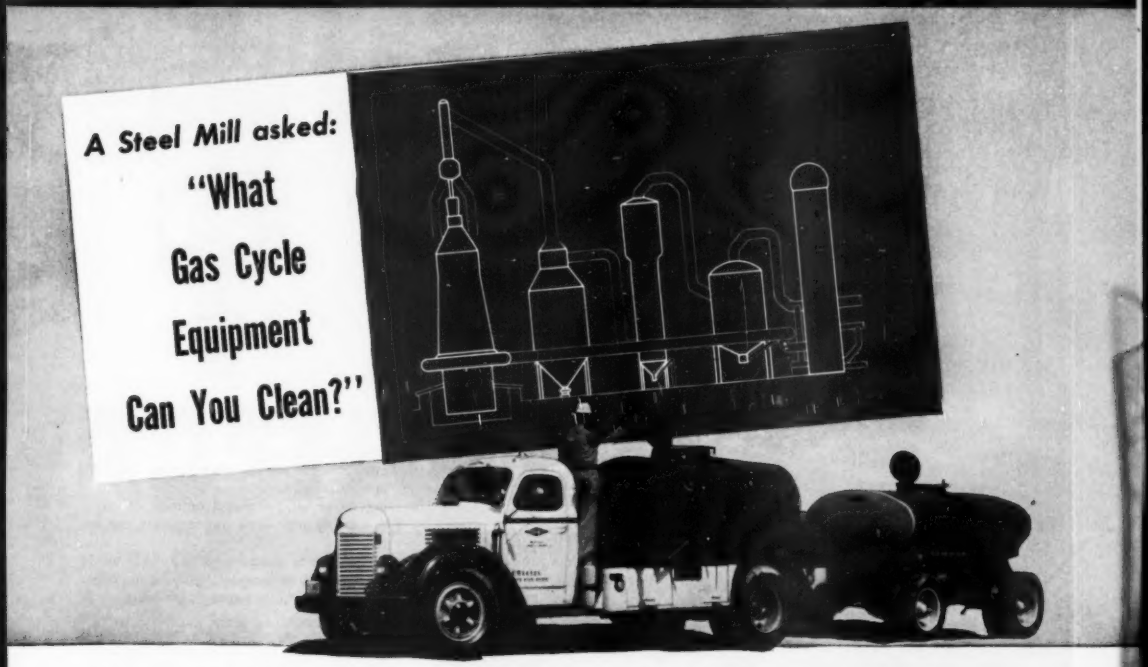
Don't wake up tomorrow with a GUILTY charge. Better check your plant thoroughly TODAY.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



DOWELL SERVICE has cleaned all types . . . FASTER . . . BETTER

Cleaning of blast furnace gas cycle equipment is a major Dowell Service to the steel industry. Practically every piece of equipment found in the cycle has been cleaned by Dowell Service.

Through the use of solvents, applied by special techniques, deposits can be removed faster and better than by mechanical methods. Dowell engineers are experts in the cleaning of industrial equipment. Dowell furnishes all necessary trained personnel, chemicals, pumps and controls. No special scaffolding is required. Dismantling and downtime are kept to a minimum . . . some equipment can be cleaned while in operation.

BLAST FURNACE COOLING SYSTEMS: Cooling coils and plates were cleaned by using Dowell solvent as coolant. Twenty sections were cleaned in one day, increasing cooling water flow five times.

ELECTROSTATIC PRECIPITATORS: By flooding weirs and ponds with Dowell solvent, caked dust and corrosion products were effectively removed. Dowell Service did the job in 12 hours, saving more than 177 hours over old-fashioned reaming and scraping.

GAS WASHERS: Instead of manual cleaning, Dowell Service pumped solvents directly into the scrubbing water without reducing wind on the furnace or otherwise interrupting operations. Washer was cleaned in four hours.

BLAST FURNACE STOVES: Gas heating efficiency of two stoves was raised from 63.6% and 64.6% to 82.7% and 79% by Dowell Service. The cleaning was accomplished *in four working days, without dismantling the stoves.*

GAS LINES: Another job was on the gas mains from washers to precipitators. Pressure drop on these 48" and 60" mains had increased to 17" of water. Dowell Service cleaned all lines in 8 days bringing pressure drop down to 6".

DUST COLLECTOR: Dust collector was picking up 5 tons per day instead of rated 30-40 tons. Instead of shut down and manual cleaning, Dowell Service cleaned the collector *in service*, increasing dust pick-up to 30-35 tons per day.

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The buildings are Federal, State, County, and Municipal. They include universities, colleges, training schools, high schools . . . hospitals, sanitariums, asylums, soldiers' homes . . . penitentiaries, prisons, reformatories, detention homes . . . state capitols, office buildings.

Skinner Engines drive generators to furnish power and light, and compressors for refrigeration. Exhaust steam is used for space heating, air conditioning, processing, and laundry. Their records for economical, dependable operation have been established over a period of four decades, in public institutions and private industries.

Write for case studies of what has been accomplished in industries similar to yours.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 158

AUTOMATIC LUBRICATOR P237

Sight-feed lubricator that assures adequate lubrication of tube cleaners and other air- or steam-powered tools. Once set, this lubricator requires no adjustment—no turning on or off. Actuated entirely by pressure of the operating air or steam, not by flow.

As long as pressure is supplied, oil is accurately metered into the operating hose. When operating pressure is off, oil flow is shut off tight.

Although especially designed for tube cleaner service, the unit is suitable for many other types of air- or steam-powered equipment. However, since its operation is based on pressure, not flow, a shut-off valve in the operating line must always precede the lubricator. It is therefore unsuited for use with tools which are controlled at the motor. Lubricator is supplied in two sizes—one pint and one quart capacities.

Elliott Co, Roto Div, Newark, N. J.

For more data on these items, use post cards, p167. Identify request with P and number.

ELECTRICAL TAPE P232

Heavy-duty plastic electrical tape designed for applications where more-than-average mechanical strength is needed. Designated *Scotch* brand electrical tape No.

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- ☐ Nearest RUST-OLEUM Source

Look for this label — be sure it's genuine RUST-OLEUM

MODERN ENGINEERING demands precise standards of heat insulation performance. Pabco's *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

LOCAL STOCKS

Pabco Engineering Service Units are strategically located throughout the United States and maintain adequate stocks of Pabco's *Precision Molded* 85% Magnesia Heat Insulation. Regardless of your location, Pabco Engineering Units give the service and materials you need when you need them.

COMPETENT INSULATION ENGINEERS

Each Pabco Approved Engineering Service Unit is staffed with competent insulation engineers and skilled mechanics. Between each unit and the Pabco factory there is a constant cooperative interchange of experience and methods, resulting in special benefits to every customer.

SERVICE EVERYWHERE

Pabco Engineering Service Units may be found in the classified section of the telephone book, or by writing to the factory. You can depend upon every Pabco Engineering Service Unit for the same high standards of materials, workmanship and methods of application. Get the complete facts on Pabco heat insulation and service now for your future needs.

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

PABCO PRODUCTS INC.

Insulation Division
San Francisco 19 New York 16
Manufacturers of Heat Insulation
Since 1920
Pabco Engineering Service Units in all Principal Cities

More EQUIPMENT NEWS

Begins on page 158

21, it is recommended for anti-corrosion protection for pipes, cables and equipment laid underground where resistance to cuts and abrasion by rocks during back-fill is important.

Also recommended for protecting and insulating cable and high tension leads subject to wear, abrasion and rough handling, and for bus bars carrying high voltage. Tape has a black, vinyl plastic backing that is 20 mils thick—more than twice the thickness of previous tapes of its type. It has a dielectric strength of 22,500 v, an insulation resistance of 200,000 megohms, and an electrolytic corrosion factor of 1.0. Tape is available in 36-yd rolls ranging in widths from ¼ to 16 in.

Minnesota Mining and Mfg Co, 900 Fauquier St, St. Paul 6, Minn.

For more data on these items, use post cards, p167. Identify request with P and number.

DUST COLLECTOR P201

Low cost, self-contained dust collector, the model *JS dustbuster*, heretofore restricted to 50 or 60 cycle operation is now available for 25 cycle service. Unit's efficiency and its rated 650 cfm suction depend on 3600 rpm fan speed; V-belt overdrive has been added for lower frequency operation.

Ratings of this unit taken with standard test instruments show 633 cfm on a 5-in.-dia inlet (equal to 4800 rpm). Double 3-in., single 4-in. and single 5-in. inlets are optional. Floor space required is 24x26 in., overall height 70 in. Weight, crated for shipment, is 260 lbs.

Aget-Detroit Co, Ann Arbor, Mich.

MOTOR CONTROL CENTER P239

Center for use wherever two or more ac motors, up to 200 hp, 600 v, are controlled from a central location. Pre-engineered, factory wired and assembled, and employing many standard components and accessories, this center was developed for use in power stations, public buildings, paper mills, chemical, petroleum, steel, rubber,

CHAPMAN LIST 960

the one Forged Steel Gate Valve that gives you this 4-WAY PROTECTION

Extra Protection Against Even Unusual Stress is provided by extra-strong stem-and-wedge-gate connection.

Repairs and Replacements Are Reduced by super-hardened seat rings and gate faces of stainless steel.

Longer-Lived Body and Yoke are of forged steel. And bolted follower has no threads on yoke to corrode.

No Seizing or Galling of Gate Faces because List 960's gates (when furnished with certain types of trim) are hardened by *Malcomizing* (patented Chapman process) to a minimum of 800 Brinnell.

An exceptionally wide range of services is covered by this small forged steel gate valve . . . giving you the same consistent top level performance on many different jobs.

Chapman List 960 Forged Steel Gate Valves are manufactured in sizes from ½" to 2" inclusive, and in these 2 types: (1) Rising stem with yoke (shown), and (2) Rising stem with inside screw. Bonnet joints are either gasketed or metal-to-metal. Pressure range: 2000 lb. at 100°F. — 380 lb. at 1000°F. For higher pressures, specify List 990. Send for illustrated Catalog No. 10.

THE CHAPMAN VALVE MFG. CO., INDIAN ORCHARD, MASS.

What's a 4-Letter Word for LONG LIFE?

D-A-R-T ...YOU CAN USE ONE Over and Over Again!

This True Ball Joint Makes the Difference

Darts last longer and hence cut your maintenance costs for three reasons:

1. **NON-CORROSIVE BRONZE SEATS**
   Both seats are made of non-corrosive bronze for maximum protection against pitting and corrosion.
2. **PRACTICALLY INDESTRUCTIBLE NUT AND ENDS**
   The nut of a Dart and both ends are constructed of high test, air refined malleable iron. You get peak resistance to stress, stretching and wrenching.
3. **DROP-TIGHT WITHOUT EXCESSIVE WRENCHING**
   Even though a Dart can *take* heavy wrenching, you don't have to *give* it! Because it's precision ground to a perfect sphere, the true ball joint gives a snug, drop-tight fit easily, quickly. It *stays* tight, too.

In repeated use, longer life, easier installing—Darts give you MORE for your union money!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART UNIONS

More EQUIPMENT NEWS

Begins on page 158

ore, food, and other processing plants.

Center is designed to withstand short circuit stresses up to 25,000 amp. Its sections, each measuring 20-in. deep, 20-in. wide, and 90-in. high, join together to form a strong, free-standing, completely dead-front, NEMA I enclosed, control assembly.

One of the main features of the new design is a 4-in. vertical trough (with cable supports) which runs the full length of each section, providing ample space for wiring. No threading through or fishing is necessary because metal barriers which separate the starter units are easily removed, leaving a continuous wiring trough.

General Electric Co, Schenectady 5, N. Y.

"EVERY TIME SHE GOES BY, OUR TEMPERATURE RECORDERS START ACTING UP!"

CATION EXCHANGERS P207

The phosphonic and phosphoric acid groups have been put to work in new sample line of cation exchangers now available for experimental work. Properties of these exchangers have not been completely determined, but they are expected to show interesting characteristics as adsorbents as well as cation-exchange resins.

Studies to date indicate the first hydrogen ion is moderately strong and splits salts in much the same way as does the sulfonic acid group, but the second hydrogen ion is quite weak and comes into action only at high pH's.

Chemical Process Co, Box 829, Redwood City, Calif.

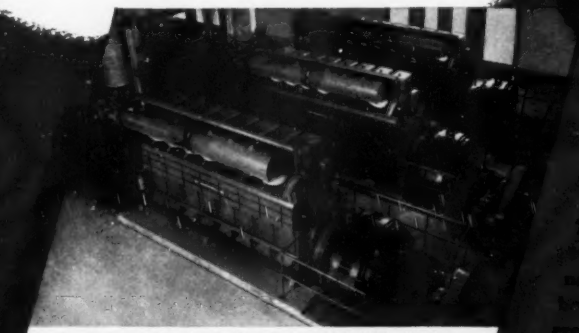
For more data on these items, use post cards, p167. Identify request with P and number.

SMOKE DETECTOR P209

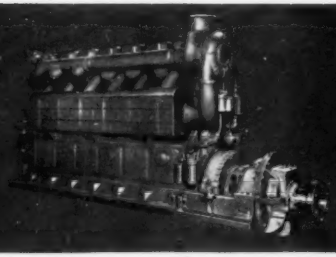
Three-unit photoelectric smoke indicator and control, the *De-Tec-Tronic*, consists of (1) light source (2) photoelectric cell whose output is proportional to smoke density (3) master control with amplifier, relay, smoke-density-meter calibrated in Ringelmann units, and signal lights. Light

How to DOUBLE YOUR HORSEPOWER WITHOUT INCREASING YOUR FLOOR SPACE.....

with the NORDBERG *Supair Thermal* Engine



Above: Three 8-cylinder Nordberg FS-138-HSC, *SUPAIR-THERMAL* 1000 kw, 450 rpm generating units at N. V. Overzeese Gas En Electriciteit Maatschappij, an electric utility in Aruba, N. W. I.



Above: Nordberg 6-cylinder FMD-136-HSC, *SUPAIRTHERMAL* engine developing 800 bhp at 300 rpm, for direct drive—direct reversing—propulsion of tugboat owned by Foss Launch and Tug Company, Tacoma, Wash.

A DIVISION OF NORDBERG

NORDBERG

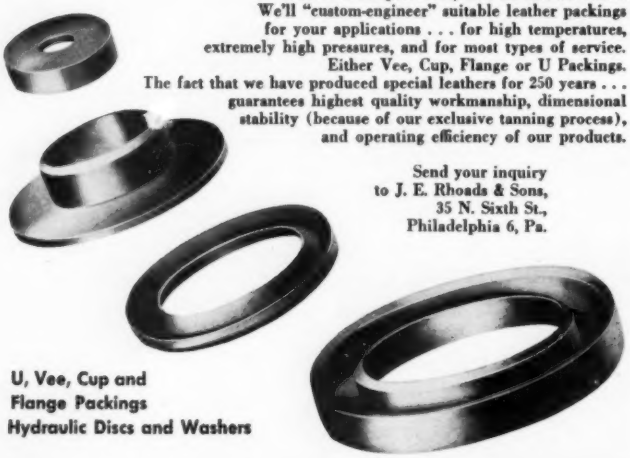
DIESEL ENGINES

"packing" trouble?

We'll "custom-engineer" Leather Packings to suit your requirements

Naturally, Tannate mechanical leather packings require less maintenance, do not require lubrication, are not affected by sub-zero temperatures, and do not cold-flow. We'll "custom-engineer" suitable leather packings for your applications . . . for high temperatures, extremely high pressures, and for most types of service. Either Vee, Cup, Flange or U Packings. The fact that we have produced special leathers for 250 years . . . guarantees highest quality workmanship, dimensional stability (because of our exclusive tanning process), and operating efficiency of our products.

Send your inquiry to J. E. Rhoads & Sons, 35 N. Sixth St., Philadelphia 6, Pa.



U, Vee, Cup and Flange Packings Hydraulic Discs and Washers

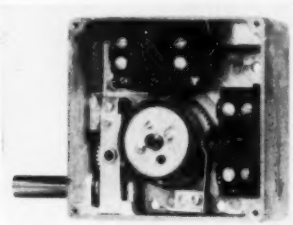
250 J. E. RHOADS & SONS
PHILADELPHIA • NEW YORK
CHICAGO • ATLANTA
YEARS PRODUCING FINE LEATHERS

More EQUIPMENT NEWS

Begins on page 158

source and photoelectric cell units mount on opposite sides of breeching or smoke chamber and center over two 2-in. holes in the breeching walls. Both light source and photocell unit are spaced away from the breeching, permitting natural air drafts to keep lenses cool and clean.
De-Tec-Tronic Laboratories, Inc, 1711 Terra Cotta Place, Chicago 10, Ill.

For more data on these items, use post cards, p167. Identify request with P and number.



LIMIT SWITCH P234

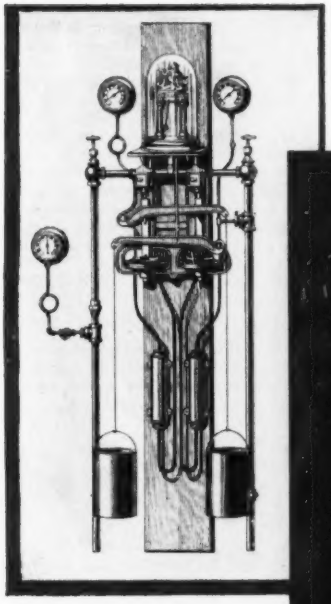
Rotating-type limit switch for use where reversing operation is co-ordinated with the number of revolutions of a motor shaft or driven equipment. Switch can be used to control motor-operated doors and windows, valves on machine tools, baling operations, travel limits on machinery, etc.
General Electric Co, Schenectady 5, N. Y.

OUTDOOR MOTOR CONTROL P224

Rain-tight outdoor motor-control units originally designed for irrigation projects, yet applicable to many other outdoor motor-control jobs. Consist of a combination

ADSCO HAS COME A LONG WAY IN

75 years



IN celebrating our 75th anniversary this year, we have been reflecting on the great advancement of steam distribution equipment since 1877, when the founders of ADSCO built the first district heating system. Compare, for example, the old-time flow meter shown at left and the rugged, compact condensate meter ADSCO makes today. The modern meter, with a much higher degree of accuracy, measures any clear liquid under gravity as well as steam condensate. In all our products — expansion joints, heat exchangers, pipe accessories, and meters — we have constantly striven for improvement in design and manufacture. Our present undisputed leadership is proof of our progressive organization — always keenly aware of the needs of our customers.

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK

ADSCO
75 YEARS OF LEADERSHIP

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY . .

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS . . .

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME . . .

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

CD-35A

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICALS FOR ALL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

More EQUIPMENT NEWS

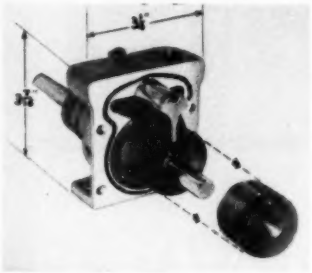
Begins on page 158

across-the-line starter with circuit breaker in a rain-tight enclosure, plus a built-in *start-stop* pushbutton or *hand-off-auto* selector switch. Sheet steel enclosure is Bonderized for maximum corrosion resistance, and is finished in gray enamel.

Self-indicating slamproof handle is provided for operation of the circuit breaker. This handle has separate positions for *on, tripped, off, reset,* and *open cover,* and can be padlocked in the *off* position by up to three separate padlocks. These starters, designated as Class 11-206-NR, are available in NEMA sizes 1 through 5. Standard voltages are 220 and 440, 60 cycles, although with proper coils the starters are suitable up to 600 volts.

Westinghouse Electric Corp, Box 2699, Pittsburgh 30, Pa.

For more data on these items, use post cards, p167. Identify request with P and number.



STAINLESS-STEEL PUMPS P215

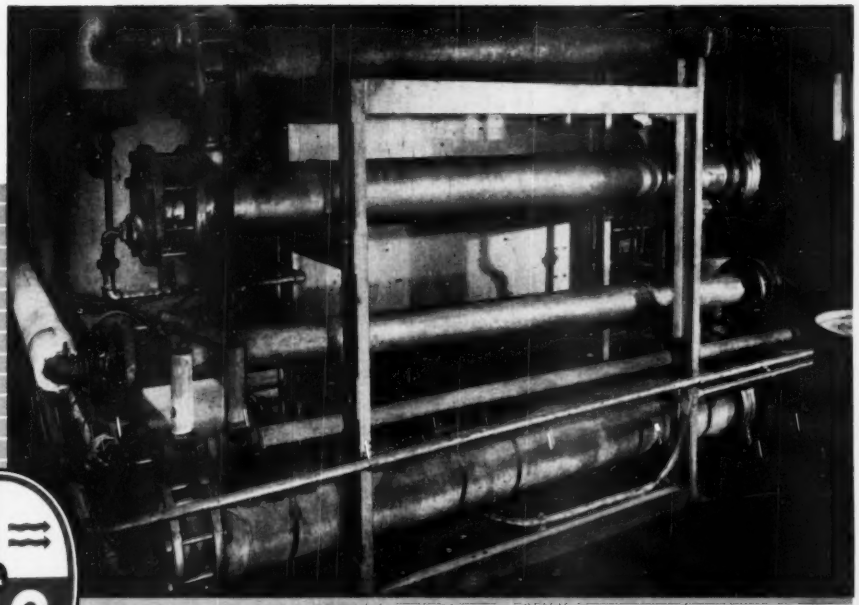
Allchem pumps have *teflon* impellers, teflon-packed stuffing box and a choice of teflon or *graphitar* self-lubricating bearings as standard equipment. Built with stainless-steel casings and shafts, these compact pumps are suited for small-volume process or laboratory work. Positive displacement units, they run in either direction and handle 1 to 20 gpm at pressures to 40 psi. Construction and materials used permit these pumps to handle virtually all fluid chemicals in the widest viscosity ranges, and simplify purchasing. They have a self-priming feature built in. Port sizes available are ⅜, ½ and ¾ in. Belt or direct drive is one of many optional features.

Eco Engrg Co, 12 New York Ave, Newark 1, N. J.

GAS ALARM P208

Completely explosion-proof construction featuring a bell-shaped cover housing and weather-proof sensing unit, permits outdoor or indoor mounting of model EE combustible gas alarm. By convection and diffusion, the surrounding atmosphere is continuously watched for build-up of any kind of explosive vapor. Presence of such vapor lights a bright-red indicator and

Battery of B&G Gas and Liquid Coolers

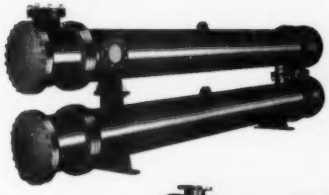


Hydro-Flo HEAT EXCHANGERS

Standard Design or built to your specifications

B & G *Hydro-Flo* Heat Exchangers are made in so wide a capacity and utility range that many requirements can be satisfied with standard units. If, however, special designs or materials are necessary, B & G equipment can be built to your specifications. The B & G engineering staff is always ready to assist in every way possible.

Whether standard or special, you'll find that B & G Heat Exchangers will meet your most critical appraisal. Sound design, backed by painstaking workmanship and rigid inspection assure equipment of top efficiency and long life. *B & G Hydro-Flo Products deliver more value per dollar because they are built that way!*

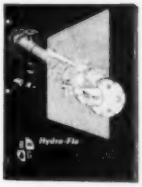


Two single pass, channel head B & G Heat Exchangers for series operation.

High pressure B & G Molasses Heater with fixed tube sheets and expansion joint design.

B&G Hydro-Flo shell-and-tube heat exchangers are available in the following types:

Straight and "U" Bend Tube Heat Exchangers • Fuel Oil Preheaters • Tank Suction Heaters • Aftercoolers • Gas Coolers • Water Heaters • Refrigeration Condensers and Evaporators.



SEND FOR CATALOG DM-1150

B & G CENTRIFUGAL PUMPS

Complete line for application in process industries and refrigeration and air conditioning installations. Send for catalogs.

BELL & GOSSETT COMPANY

Dept. CJ-36, Morton Grove, Ill.

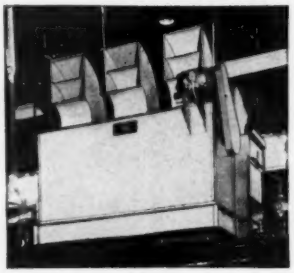
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto, Canada

• Reg. U. S. Pat. Off.

New HIGH PRESSURE STEAM Fan Heater

Gives Savings You Never Had Before

The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.



HOW IT OPERATES: — A dual coil system makes use of all heat, both sensible and latent. High pressure steam enters the upper coil, shown on the diagram below. Its condensate drains into a trap. Then this high pressure condensate is released into the header of the lower coil. It instantly flashes into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to the vapor condensate return header by a drain tube that also gives off its heat into the air stream.

The vapor condenses in the lower coil. Its condensate is kept at a high level in the return leg by a wier in the return header so that all its heat is made useful and it is sub-cooled by contact with the coldest air entering the heater. Vacuum condensate return to boiler is vapor free.

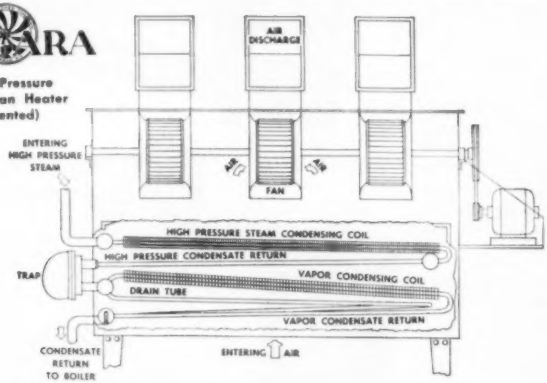
HOW IT SAVES IN COST: — Piping is much simpler and less costly than in low pressure systems. Much secondary piping, traps and big valves are not needed. Pipe sizes are smaller.

HOW IT SAVES IN OPERATION: — Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: — Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Properly engineered for the job, final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate. Heaters are self-draining on shut-down. Heaters are strongly built; all coils including the condensate drain tubes are hairpin bend, stress relieving. Use thru four heating seasons has proven these advantages in large scale plant heating.

NIAGARA

High Pressure Steam Fan Heater (Patented)



NIAGARA BLOWER COMPANY
Dept. P, 405 LEXINGTON AVE., NEW YORK 17, N. Y.

Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.

Name .....

Address .....

More EQUIPMENT NEWS

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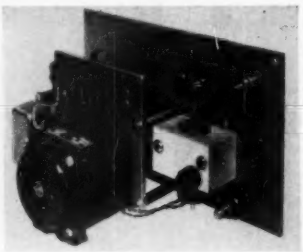
various remote alarm units that can be connected to special terminals. Standard alarm point is 0.2 of the lower explosive limit. Either self-reset or lock-in arrangements can be provided, to give a choice between on-off indication of gas, or one that must be manually reset.

Johnson-Williams Ltd, 2710 Third St, Palo Alto, Calif.

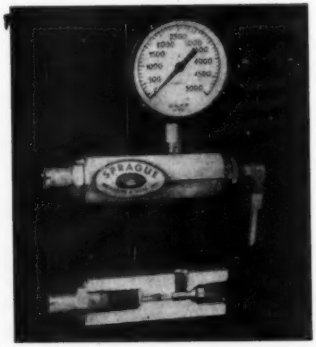
For more data on these items, use post cards, p167. Identify request with P and number.



SERVOMECHANISM P231

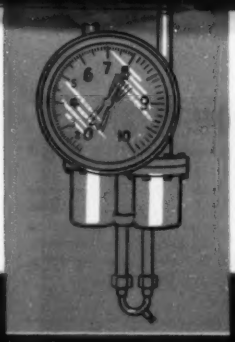
Designed to remotely position a dial pointer, recorder, pen, mechanical counter, printing mechanism, switch cam, pulley wheel, gear train, etc with high accuracy. The *Atcotran Servo* employs an electrical null-balance differential transformer measuring system actuated by a two-phase low inertia motor. Continuous null-balance operation unaffected by line voltage variations of ± 10%.

Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa.



PRESSURE-GAGE SHUTOFF P217

This shutoff automatically cuts out pressure gages when system pressure exceeds gage operating limit. It automatically opens gage to system when pressure returns to operating range. Available for low and high pressures starting at 3 psi and going up to 5000 psi. Compression spring con-



Make BS&B SAFETY HEADS Your Partners in Protection!

Pressure relief valves, long a standard for protecting pressure equipment, do a good job in ordinary pressure relief situations. But new products and processes of chemistry have complicated the problem of pressure protection by increasing the incidence of corrosion, gumming, rust, excessive heat and cold, and violent pressure surges. There are times when a valve becomes plugged up or corroded and fails to function properly, or where pressure builds up so fast that its relieving capacity cannot handle the load.

This new situation has caused the accurate, fast-acting BS&B Safety Head to become an indispensable partner for protecting modern pressure systems. When the rupture disc—a controlled zone of weakness—breaks, it leafs out, giving a full-throated, unrestricted opening.

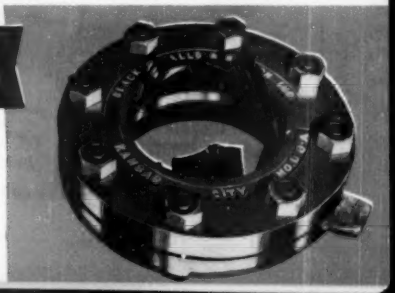
The BS&B Safety Head, a patented pressure relief device, is designed to become an integral part of any pressure system and consists of a preformed metal rupture disc (and a vacuum support, when required) that is held between two specially-machined flanges. The disc is designed to rupture at a predetermined pressure, and is guaranteed, when sold, to rupture within 5%—plus or minus—of its designed pressure at room temperature. By fabricating rupture discs from a wide variety of metals and using protective coatings, Safety Heads can be used with all types of gases or liquids at disc pressures ranging from 5 to 50,000 pounds per square inch.

As a primary relief device, the versatile BS&B Safety Head can be used in series ahead of a relief valve, or at valve outlet.

Solve pressure protection problems by having an experienced BS&B Safety Head Engineer analyze your relief requirements now.

SAFETY BS&B HEADS

Write today for your copy of the BS&B Safety Head Catalog.



BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2Q2
7500 E. 12th Street Kansas City 3, Missouri

COMPACT

within arms' reach

MORE STEAM
in LESS SPACE... at LESS COST!

The Clayton Forced Recirculation Steam Generator produces more steam per pound of weight and per cubic foot of space occupied than any boiler known... and at less cost. Fast steaming, automatic and safe, the Clayton Generator sets a new standard of efficiency for the production of processing steam. It is the only steam generator with a cost curve that parallels the load demand curve through all stages of operation. Each unit... 15 to 100 h. p.... is complete, ready to connect and operate upon delivery. No burners, pumps, instruments or accessories to buy.

THIS COUPON BRINGS PROOF TO YOUR DESK

An animated, colored flow chart shows you how and why the Clayton Forced Recirculation principle can cut your steam costs.

P-2

CLAYTON MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.

NAME_____

FIRM_____

ADDRESS_____ STATE_____

CITY_____

Clayton

MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA

More EQUIPMENT NEWS

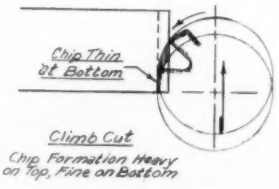
Begins on page 158

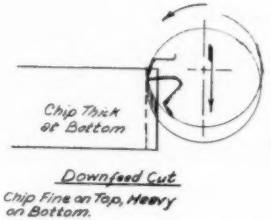
trols pressure shutoff point. Minor changes or adjustments are made by turning adjusting screw at one end of shutoff. System connection is ½ in., gage connection ¼ in. **Sprague Engrg & Sales Corp, Gardena, Calif.**

For more data on these items, use post cards, p167. Identify request with P and number.

SELF-DUMPING TRAILER P205

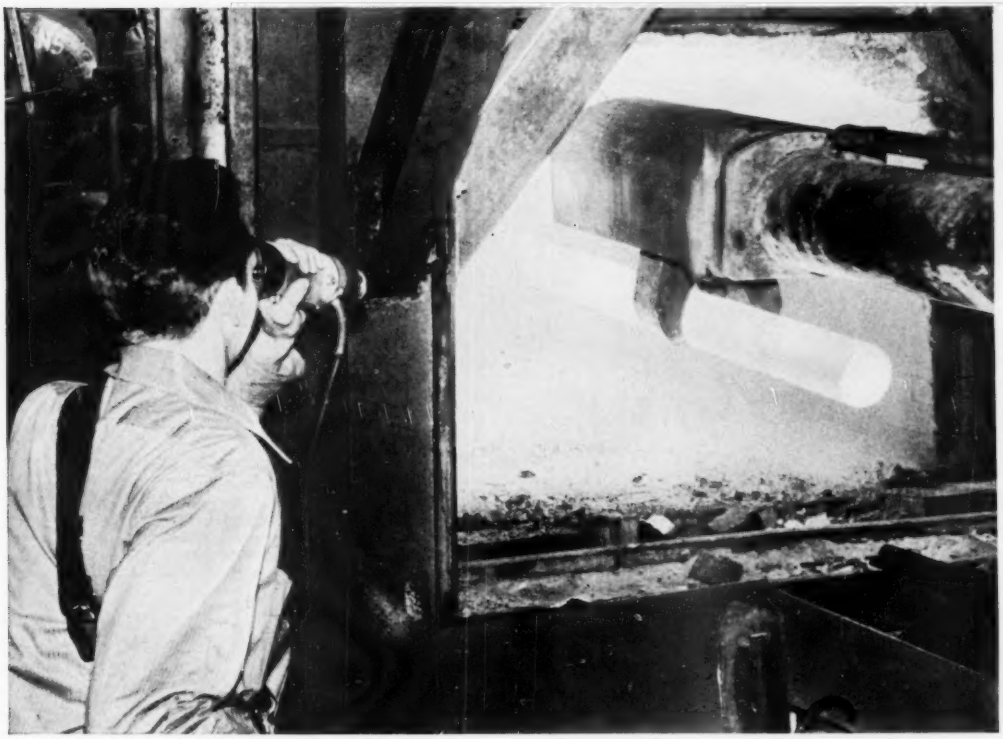
Conveniently sized for one-man handling, *Phil-Dump* model T-SRF-½, self-dumping trailer features a sturdy tongue for manual and tractor handling as well as pockets for prongs of a fork lift truck. Made of heavy gage steel, all-welded construction. Wheels are equipped with roller bearings and solid rubber tires; two of the wheels are castered for easy maneuvering. **Phillips Mine & Mill Supply Co, 2374 Jane St, Pittsburgh 3, Pa.**





UNIVERSAL GEAR HOBBER P206

Spur, spiral and worm gears can be cut by *Cima* gear-hobbing machine employing *climb-cutting* method. Chip produced in climb-cutting is thick on top and thin on



GLOBE

Complete Process Control . . . from billet – to tube – to fitting

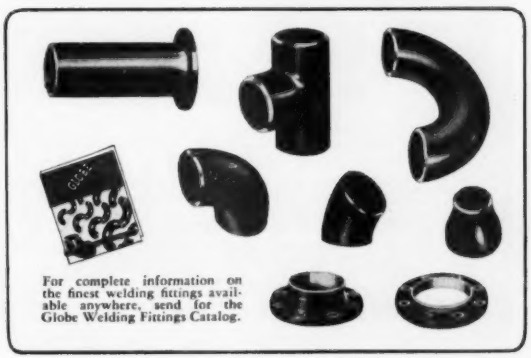
assures you the finest in WELDING FITTINGS

Only Globe's precision process of manufacturing seamless welding fittings *begins with the billet*! For Globe alone among welding fitting manufacturers produces seamless tubing . . . and Globe alone has the facilities to provide exact technical control at every stage of manufacture — from billet — to tube — to fitting — *in its own plant.* That's one reason why users who want dependable fittings specify Globe!

GLOBE STEEL TUBES CO.
MILWAUKEE 46, WISCONSIN

Chicago • Cleveland • Detroit • New York • Philadelphia • St. Louis • Denver • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high-purity ingot iron) seamless tubes — Globe Welding Fittings.

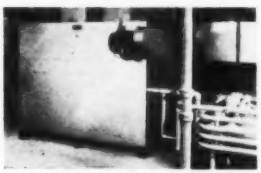


For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

Don't be fooled...

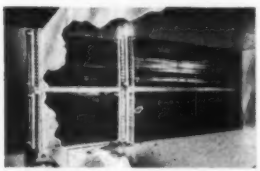
Radiation can sometimes fool the "experts." Four tin cans — one painted white, one black, one highly polished and one covered with asbestos, after being filled with boiling water will cool at different rates. Which should cool most rapidly? Fill four cans as shown and record temperatures. Kirchoff's law still holds!

Radiation, conduction or convection — Bush finned surfaces offer high heat transfer coefficients meaning greater economy in coil size for a given load. Heating or cooling for product or comfort, there's a Bush unit to answer the need. Write for catalogs 350 and 425 which describe the Bush line and in addition contain valuable engineering data.

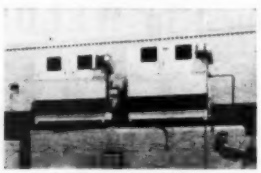


Air Conditioning Units 2 to 70 tons capacity for cooling, heating. 1800 to 18,000 CFM.

Standard Pipe Radiation. For heating. Copper tube, aluminum fin or all steel.



Water coils of copper tube aluminum fin for cooling, heating. Wide variety of sizes.



Cooling Towers and Evaporative Condensers 3 to 75 tons. Cuts water consumption 90%.

BUSH MANUFACTURING COMPANY

WEST HARTFORD 10, CONNECTICUT

More EQUIPMENT NEWS

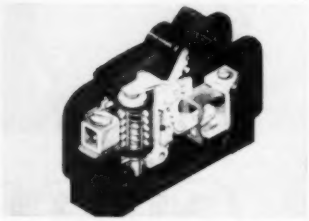
Begins on page 158

the bottom, quite different from conventional down-feed method. There is much less material to be removed at the bottom of the cut, and a much better tooth flank finish results. Feed per hob revolution can be safely increased without impairing finish or tooth accuracy.

The *Cima* is the universal type, for spur gears. Comes equipped with differential mechanism to simplify cutting spiral gears. Cutter head has tangential feeding for turning out multiple-start worm gears with greater accuracy and full contact without ridges on the tooth flanks. Worm gears can be produced with fly cutters, a valuable feature for repair work, since worm gear can be replaced even though no hob is available. Machine table measures 19 in., hob, 5 in. dia. by 6 in. length; weighs 4000 lbs.

Geo Scherr Co, 200 Lafayette St, New York 12, N. Y.

For more data on these items, use post cards, p167. Identify request with P and number.



CIRCUIT BREAKER P233

New design of the *Magnette* panelboard circuit breaker makes it interchangeable with many other conventional breakers. Since it has no thermal elements, its rating is not affected by room or internal panelboard temperature. On simple overloads, breaker provides for a time delay; but at 10 times the rated current or short circuit conditions it trips instantly.

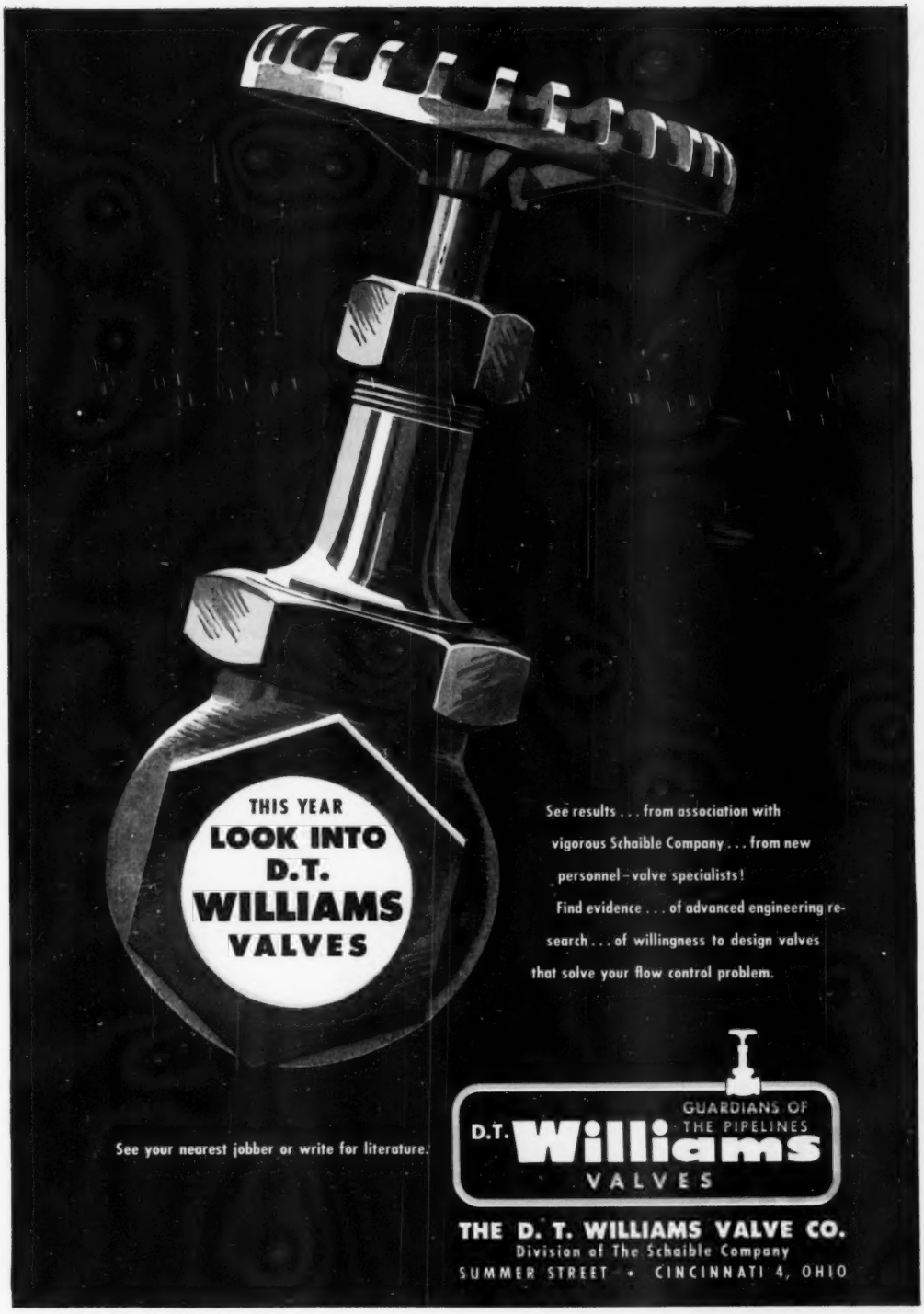
Breaker is available in single pole units, 120 volt ac, 15 to 60 amps or two pole units, 120/240 volt ac, 15 to 35 amps, approved by Underwriters' Laboratories. Complete information in Bulletin 3101.

Heinemann Electric Co, Trenton 2, N. J.

LINE TYPE PURIFIER P202

Compressed air, gas, vapor and steam lines operate better with a more efficient removal of entrainment. New series of *Hi-eF* purifiers can remove solids from exhaust steam installations. This guck fouls automatic regulating equipment to add to maintenance, reduce heating efficiency and lengthen downtime. When vented, it damages plant equipment and creates a public nuisance as well in neighboring areas.

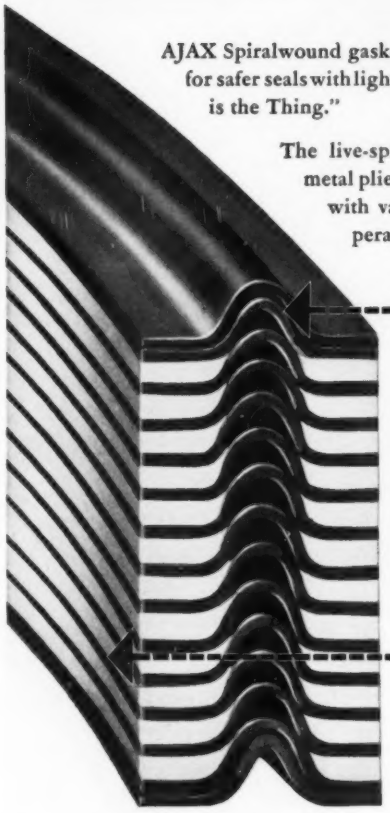
The company further claims these purifiers remove condensate from compressed air lines, deliver clean, dry steam for food


THIS YEAR
LOOK INTO
D.T.
WILLIAMS
VALVES
See results . . . from association with vigorous Schaible Company . . . from new personnel–valve specialists!
Find evidence . . . of advanced engineering research . . . of willingness to design valves that solve your flow control problem.
See your nearest jobber or write for literature.
GUARDIANS OF THE PIPELINES
D.T. Williams VALVES
THE D. T. WILLIAMS VALVE CO.
Division of The Schaible Company
SUMMER STREET • CINCINNATI 4, OHIO

the Spring is the thing

AJAX Spiralwound gaskets have built in resilience for safer seals with lighter bolt-loads. "The Spring is the Thing."

The live-spring action of U-shaped metal plies lets this gasket "Breathe" with varying pressures and temperatures.



Multiple knife edges bite into flange surfaces. Each ply is a separate seal.

Thrifty. Ajax gaskets can be reused because they don't lose their resiliency under compression.

Materials of construction meet all gasket requirements. Metals are plated low-carbon steel or stainless. Fillers are Canadian or Blue African asbestos or chemically inert TEFLON.* Sold universally through Industrial Distributors. Ask your Mill Supply House or write

*du Pont's trademark for its tetrafluoroethylene resin.

UNITED STATES GASKET COMPANY

680 N. 10TH STREET, CAMDEN, N.J.

LEADING FABRICATORS OF "TEFLON" FOR THE CHEMICAL, PROCESS AND ELECTRONIC INDUSTRIES

More EQUIPMENT NEWS

Begins on page 158

processing, prevent line scale and liquid contamination in process gas and air lines, and remove entrainment in vapor lines following operation.

V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio

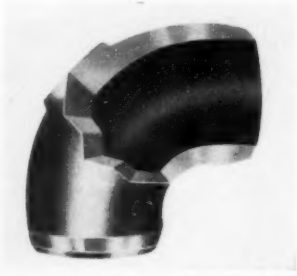
For more data on these items, use post cards, p167. Identify request with P and number.

OIL PRESSURE LOADER P229

A panel-mounted oil pressure loader for manually controlling oil pressure to devices normally operated automatically. Both automatically and manually controlled pressures are indicated on gages, so operator can avoid discontinuity by matching the two pressures before switching from one control to the other. A three-way valve selects the mode of control.

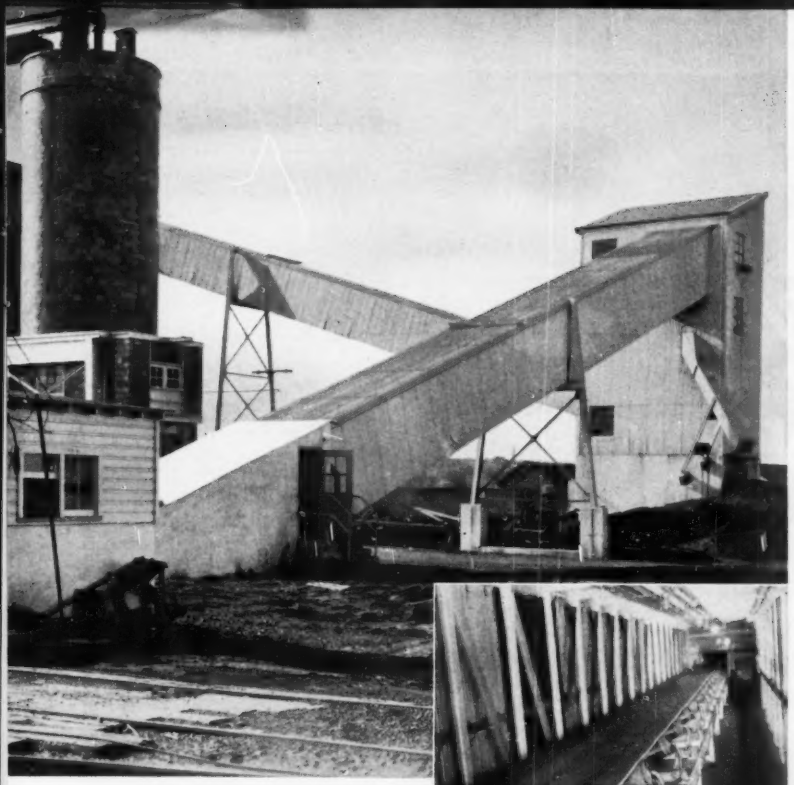
Device is especially useful in starting up hydraulically-controlled equipment. Standard output pressure range is 0-60 psig with an oil supply pressure of 100 psig. Variations in supply pressure do not affect output pressure unless supply pressure falls to within 5 psig of output pressure. Bulletin 156 fully describes the unit.

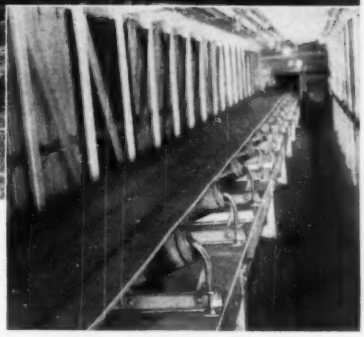
Askania Regulator Co, 240 East Ontario St, Chicago 11, Ill.



ALLOY WELDING FITTINGS P220

Key-Kast alloy-steel welding pipe fittings and flanges are based on a new design of greater wall thickness throughout





Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

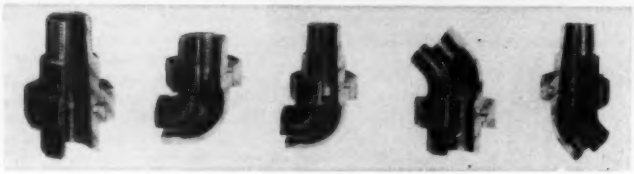
STANDARD OIL COMPANY **STANDARD** *(Indiana)*

Jefferson

AIR-TESTED
AIR-REFINED
MALLEABLE IRON

UNIONS

featuring the
RECESSED
BRASS SEAT

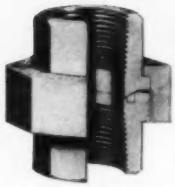


Better Piping Systems at lower piping cost...

CAN BE YOURS

You can improve your piping systems and make worthwhile savings in installation costs by using Jefferson Unions.

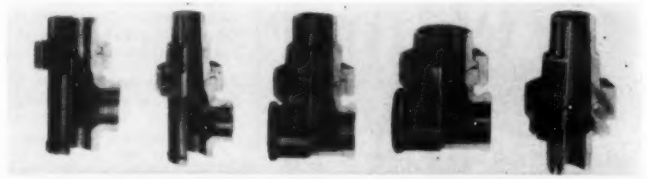
These advantages are made possible by the exclusive Jefferson Recessed Brass Seat—a feature which provides surface contact, is protected from pipe ends and results in free flow through the joint . . . a joint set up tight with minimum pressure.



Get in touch with your nearest distributor—or direct with us—for your requirements.

In nearly every case where Jefferson Specialty Unions are used, savings in time, material and labor are realized because fewer threaded joints and nipples are required. And with every such joint eliminated there is a corresponding elimination of a possible source of leakage.

Jefferson also makes AAR male and female unions, Endur 300#, Excel 250# and Master 150# unions. All-iron seats can also be furnished in all types.



Jefferson UNION CO.

605 W.26thST., NEW YORK 1,N.Y.

63 Gooding St.,Lockport,N.Y. 39 FletcherAve.,Lexington 73,Mass.

More EQUIPMENT NEWS

Begins on page 158

and added thickness at areas of stress. Fittings are said to be stronger and give longer life to piping systems at lower unit cost. They meet ASA, ASME and ASTM standards, are available in low and intermediate alloys and various types of stainless steel. All sizes and schedule numbers are included in this line. Boss on all fittings is for tapped opening.

Key Co, East St Louis, Ill.

For more data on these items, use post cards, p167. Identify request with P and number.

LOW RESISTANCE OHMMETER P236

Ohmmeter is supplied in two models, both having the same ranges of 0 to 1000 and 0 to 10,000 microhms. Model 1 B is a battery-powered set using 2 dry cells. Model 1 R has a built-in rectifier that can be plugged in to any ordinary lighting circuit outlet.

Complete units, with batteries or rectifier, weigh about 19 lbs. There is a wide variety of applications, such as routine tests on circuit-breaker contacts, relay switches, bonds, connections and joints, and bar-to-bar tests on commutator type armatures.

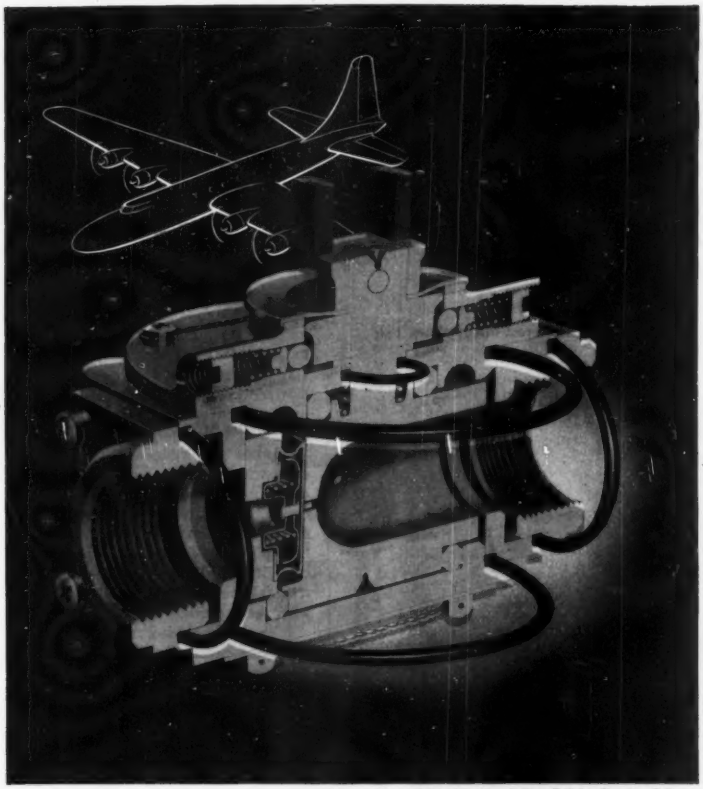
James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

FLAME FAILURE SAFEGUARD P203

Semi-automatic or manually-fired gas, oil, and combination gas-oil burners can be protected with reliable electronic safeguard. Actually "sees" all flames, and maintains constant guard against the danger of flame failure. When flame fails, *Fireye* System FP-4 instantly cuts off fuel. It can be wired to sound an alarm, if desired.

Consists of electronic control, Type 26SJ5, and *Firetron* scanner, 48PTI. Scanner contains the new *Firetron* tube, a photoconductive cell, and is installed in short lengths of standard ½-in. pipe located where its sensitive cell can scan the flame area.

Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.



Cutaway View of PARKER Aircraft Shutoff Valve Showing O-Rings.

Leakproof Seals...Simple to use

WHEN YOU SPECIFY PARKER O-RINGS

THIS IS IT

Cross section drawing of O-ring in groove, sealing under pressure.

PARKER synthetic rubber O-rings provide perfect, leakproof sealing with economy of weight and space . . . without special complicated design . . . just a groove for the O-ring is needed. Economical in first cost, easy and simple to replace. For moving and non-moving applications.

PARKER is the one source for all standard O-rings to meet specifications covering fuel, hydraulic and engine oil services . . . and for special service O-rings of tested and approved compounds. Ask your PARKER O-ring Distributor for Catalog 5100, or write direct to The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

Parker

TUBE FITTINGS • VALVES • O-RINGS

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Parker

O-RINGS

ARE STOCKED BY THESE AUTHORIZED DISTRIBUTORS

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B. W. Rogers Co.
P. O. Box 1030
Akron 9, Ohio

BOSTON
Irving B. Moore Corp.
65 High Street
Boston, Mass.

BUFFALO
Hercules Gasket & Rubber Co.
327 Washington St.
Buffalo 3, N. Y.

CHICAGO
Shields Rubber Co.
564 W. Randolph St.
Chicago 6, Ill.
Air Associates, Inc.
5300 W. 63rd St.
Chicago, Ill.

CLEVELAND
Cleveland Ball Bearing Co.
3865 Carnegie Ave.
Cleveland, Ohio
Neff-Perkins Co.
1360 West 9th St.
Cleveland 13, Ohio

DALLAS
Air Associates, Inc.
3200 Love Field Dr.
Dallas 9, Tex.

DETROIT
J. N. Fauver Co.
49 West Hancock St.
Detroit 1, Mich.

FORT WORTH
Adco Industries
1413 Electric Bldg.
Fort Worth 2, Tex.

INDIANAPOLIS
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229 E. South St.
Indianapolis, Ind.

LOS ANGELES
Synthetic Rubber Products Co.
1538 South Eastern Ave.
Los Angeles 22, Calif.

MIAMI
Air Associates, Inc.
International Airport
Miami, Fla.

MILWAUKEE
Allrubber Products & Supply Co.
612 South Second St.
Milwaukee 4, Wis.

MINNEAPOLIS
Van Dusen Aircraft Supplies, Inc.
2004 Lyndale Ave., South
Minneapolis 5, Minn.

NEW YORK
Durham Aircraft Service Co.
5615 Northern Blvd.
Woodside, N. Y.
Nielsen Hydraulic Equipment Co.
298 Lafayette St.
New York 12, N. Y.

PHILADELPHIA
Goodyear Supply Co.
1506 Latimer St.
Philadelphia, Pa.

PITTSBURGH
Shields Rubber Co.
137 Water St.
Pittsburgh 22, Pa.

ST. LOUIS
Metal Goods Corp.
5239 Brown Ave.
St. Louis 15, Mo.

WICHITA
Standard Products, Inc.
650 E. Gilbert
Wichita 11, Kan.

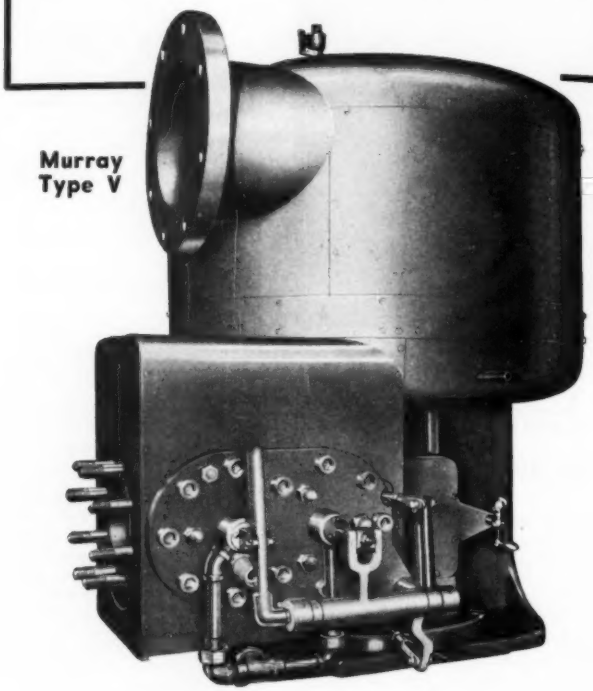
CANADA
Railway & Power Engineering Corp., Ltd.
3745 St. James St.
Montreal 30, Que.

WHY NOT TURBINE DRIVE?

Pumps, fans, compressors, special processing machines, in fact almost any machine requiring driving power can be fitted with an economical and dependable steam turbine driver selected from the many types available.

Steam turbines provide safety, low maintenance expense and ability to operate for long periods without inspection. Unsheltered installations are highly practical.

A large selection of types and frame sizes, special features and accessories are available on short delivery to suit your application.



Murray Type V

Among the newest in the Murray turbine line is the Type V vertical turbine, above. This machine provides completely enclosed construction, either direct-connected or geared for vertical pumps up to 600 HP and beyond. See that your new vertical pump is driven with a Type V steam turbine.

Contact your nearest Murray representative or write direct to—

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century.

More TECHNICAL BRIEFS

Begins on page 154

of main gas transmission pipelines is about 100,000 miles with installed compressor horsepower of approximately 3½ million.

In the past most compressors have been the reciprocating type, driven by direct-connected reciprocating gas engines, in stations 75 to 100 miles apart. Gas was compressed to a pressure ratio between 1.5:1 and 2:1. This heated the gas so that it had to be cooled before returning to the line, in order to maintain line capacity. By reducing station spacing, lower compression ratios are possible and gas cooling is no longer needed. Pump horsepower can be reduced 25 to 40%.

Studies determined the economic comparison between gas-turbine-driven centrifugal compressors and conventional direct-driven reciprocating gas engines. One study showed a 26 in. OD pipeline could deliver the same capacity with a gas-turbine-driven centrifugal compressor as a 30 in. OD line with reciprocating engines.

It was concluded the gas turbine could economically drive centrifugal compressors on gas lines 20 in. in diameter and larger. The simple single-shaft gas turbine unit proves ideal as a booster where great flexibility is not required and its use is restricted to taking care of peak loads. Where more flexibility is needed to take care of large pipeline flow variations, the dual-shaft gas turbine is required. With addition of a regenerator this unit becomes competitive on a fuel and lubricating oil cost basis. *ASME paper. No. 51-A-102.*

Directions for ordering papers on p 156

Present Development of the Reheat Steam Turbine. *By R L Reynolds, Westinghouse Electric Corp.*

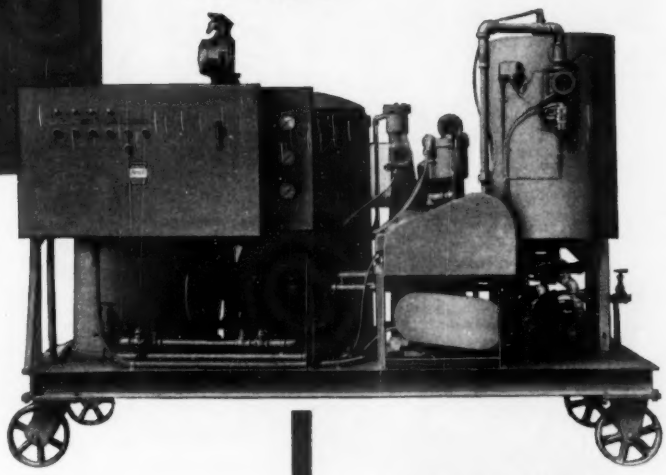
Present conditions, like high fuel costs, larger unit capacities and high operating load factors, make use of the reheat cycle increasingly attractive. Advantages and disadvantages of the reheat cycle, the degree of acceptability of this type of turbine, typical designs, operating experiences and problems are presented.

Reheat cycle advantages are (1) increases of 4 to 5% in turbine thermal efficiency when reheating to the initial steam temperature. (2) Reduction of 15 to 18% in boiler feed pump power; this further improves the station heat rate. (3) 7 to 8% reduction in condenser size. (4) Reduction in main steam generator size because of 15 to 18% reduction in steam flow. (5) About 5% reduction in fuel-burning

Houdaille Purivac

Insulating Oil Purifier

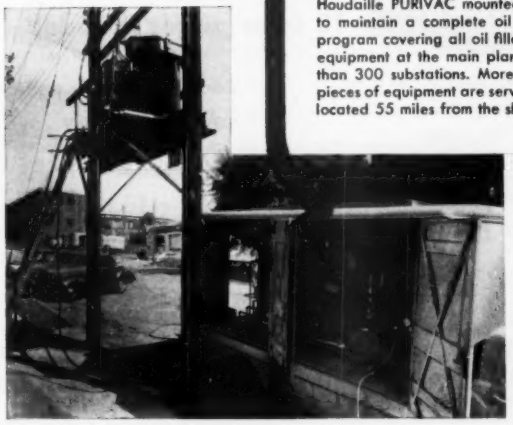
ONLY



1. Performs complete purification, dehydration and degasification. No blotter press required.
2. Performs equally well in the field or at a central station. Low operating cost.
3. No service interruptions. Purifies oil while transformers, circuit breakers, etc., are in operation.
4. Automatic, interlocking safety controls insure complete protection.

A regular program of PURIVAC oil purification reduces power failures and equipment damage caused by deteriorated oil. Utilities and power plants have proved that PURIVAC preventive maintenance prolongs the useful life of oil . . . eliminates costly transformer cleaning operations . . . restores color, neutralization number and dielectric strength of oil.

Only HOUDAILLE PURIVAC gives you this complete oil purification service. Write today for special bulletins giving complete information, specifications, case histories, laboratory reports, etc.



Omaha Public Power District employs a Houdaille PURIVAC mounted in a truck to maintain a complete oil purification program covering all oil filled electrical equipment at the main plant and more than 300 substations. More than 1200 pieces of equipment are served . . . some located 55 miles from the shop.

WORLD'S LEADING
OIL FILTER MANUFACTURER

HONAN-CRANE CORP.
1200 SIXTH STREET, LEBANON, INDIANA
A Subsidiary of
HOUDAILLE-HERSHEY CORP.

NEW, VALUABLE BOOKLET ON STATIONARY AIR COMPRESSORS

Latest Data on HOW to Save and WHY You Save By Using SCHRAMM

12 color pages include:

- Savings Provided Up to 50%
- Space-Saving Advantages
- Value of Unit System
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More TECHNICAL BRIEFS

Begins on page 154

equipment. (6) About 50% reduction in turbine exhaust moisture. (7) Reduction in size of feedwater heating equipment. (8) Reduction in size of low pressure blading because volumetric steam flow is reduced 7 to 8%, or, if same size blading is used, reduction in leaving losses from the turbine.

Disadvantages are (1) Additional cost of boiler reheat section, and the reheat steam piping from and to the turbine. (2) Increased cost of the steam turbine. (3) Slight increase in complexity of operation and control. (4) More floor space requirements for the slightly longer turbine and the interceptor valves, dump valve, and reheater piping. (5) Added complication in piping and valve arrangements and in provision for flexibility in the piping system. *ASME paper. No. 51-A-68.*

Directions for ordering papers on p 156

Comparative Efficiencies of Reheat and Non-Reheat Turbine-Generators. *By C W Elston and P H Knowlton, General Electric Co.*

Shows the amount of test information obtained on complete turbine-generator units since 1946; compares test results with guaranteed figures; shows how well the general performance calculation method given works.

Certain definite trends in the large turbine field are apparent:

(1) Great increase in number and average rating of units put in service. (2) Increase in use of high pressure, though no increase in the maximum established pressure. (3) Increase in the maximum, as well as in average temperatures. (4) Decided increase in maximum capability of 3600 rpm units and in the number of units built for this speed as compared with 1800 rpm. (5) Definite revival of the reheat cycle.

In view of these trends, an analysis is made of the applicable data. *ASME paper. No. 51-A-139.*

Steam Station Design

Progress Report of Reheat Boiler Design and Operation. *By W J Vogel and E M Powell, Combustion Engineering Superheater, Inc.*

The problem in the reheater is quite different from the superheater. Temperature and pressure of steam leaving the high pressure turbine decrease with a reduction of load; this increases the heat per lb of steam to be added in the reheater. No single furnace-temperature characteristics can satisfy the

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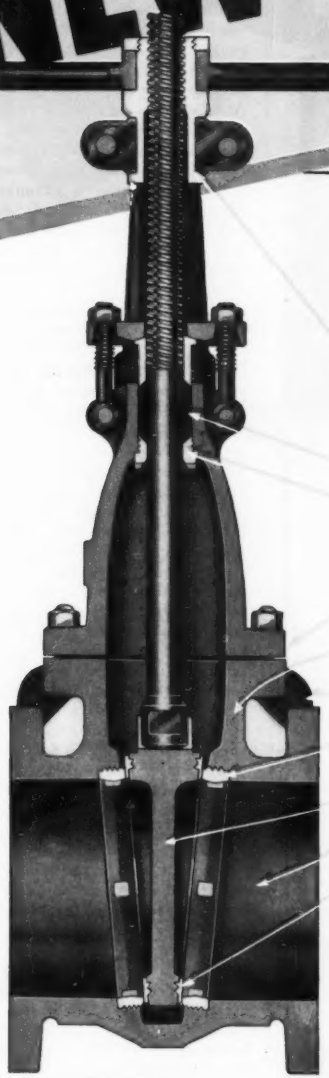

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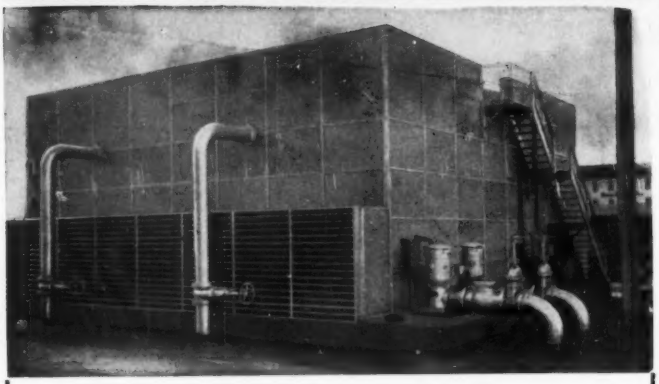

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More TECHNICAL BRIEFS

Begins on page 154

needs of both reheaters and superheaters.

In order to minimize the effects of both reheater and superheater, quantity of water to be used for (1) desuperheating (2) obtaining maximum cycle efficiency over the widest possible load range, make it necessary to set heating-surface proportions so they require the same furnace temperature at full load. At reduced load the superheater requires addition of spray water to limit the steam temperature. Quantity of water to be added for an example, the author cites, reaches a maximum at the design point (70% full load) equivalent to 1.7% of primary steam flow. The report shows how this theory actually works in practice. *ASME paper. No. 51-A-144.*

Directions for ordering papers on p 155

Design Factors in Reheat Boiler Performance and Operation. *By H H Hemenway, Foster Wheeler Corp.*

Describes reheat boilers that operate with low furnace exit gas temperatures and yet provide control of superheater and reheater outlet steam temperatures over wide load ranges. Various means for controlling primary and reheat steam temperatures and design provisions for some operating and maintenance problems are discussed.

Control system of a reheat steam generator is only a little more complicated than that for a standard unit. The control of reheat temperature of a convection reheater with by-pass control is relatively simple. Damper position affects only slightly the other components of control system. Draft loss across any component of the reheater, boiler or economizer having a by-pass section in parallel should not be used as an index of air flow because draft loss varies with damper position.

Where a radiant reheater is used, reheat temperature is controlled by differential firing between the wing furnaces and center furnaces.

Safety valves having 100% of reheater capacity should be installed between the reheater and turbine. An average installation would have valves for 75-80% of capacity before the reheater and a 20-25% of capacity after the reheater.

When it is located in a zone of high gas temperatures, reheater should be protected against sudden loss of load. Placing it after the superheater reduces possibility of damage. Adequate protection is provided by the combustion control that reduces the firing rate and hence lowers gas temperature to

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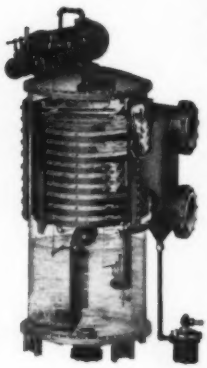

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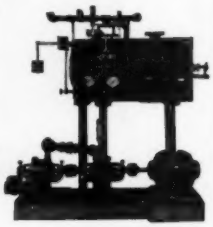

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More TECHNICAL BRIEFS

Begins on page 154

the reheater to a safe value. Bypass lines that provide emergency steam flow through the reheater will offer some protection. The amount varies inversely with gas temperatures and heat transfer rates of the reheater surface. *ASME paper. No. 51-A-142.*

Influence of Boiler Design and Operating Conditions on Steam Contamination. *By P M Brister, F G Raynor and E A Pirsh, Babcock & Wilcox Co.*

The steam drum is an important functional part of a boiler. It is here feedwater comes in and saturated steam goes out. Circulating water for the boiler leaves from this drum, partially evaporates in the steam generating circuits, and then returns to the steam drum where the steam and water separate. Chemicals for treating the boiler water usually enter at this drum, and blowdown for controlling the chemicals in the boiler water is usually taken from it. Contamination can readily develop here.

All the steam generated in the boiler comes to the steam drum in a mixture with water. It must be separated from this water (primary separation) so the water can be recirculated to the boiler together with the feedwater replacing the removed steam.

After primary separation, steam is usually not sufficiently pure to use in high-pressure turbines, so further purification is necessary. This second phase of separation is called secondary separation or steam scrubbing. It is entirely different from primary separation since it requires removal of small droplets of moisture from the steam.

The authors go on to discuss design and operating procedures to get steam of proper purity. *ASME paper. No. 51-A-95.*

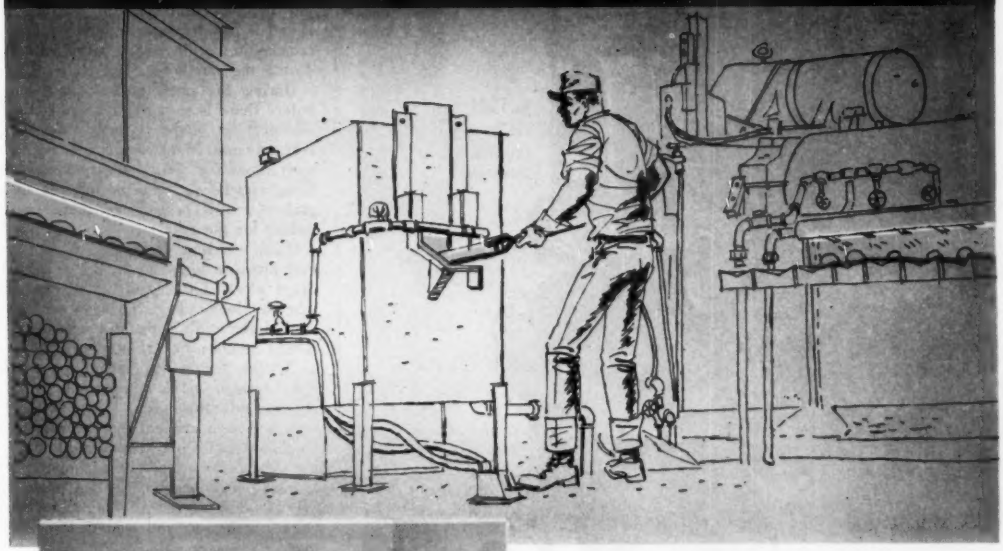
Directions for ordering papers on p 156

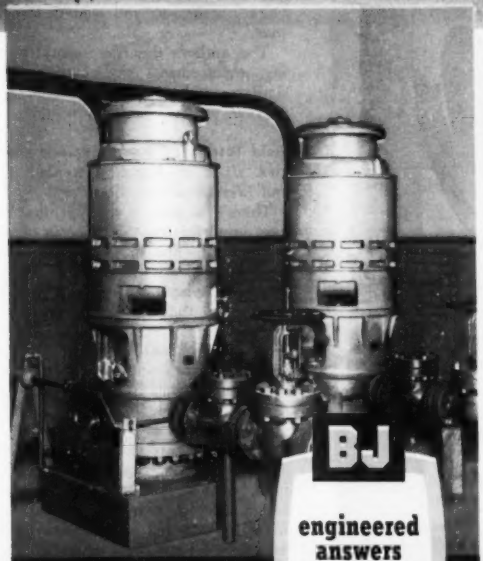
Operation and Performance of Reheat Boilers. *By P R Loughin and H H Poor, Babcock & Wilcox Co.*

There is little difference between operation of a reheat boiler and a non-reheat boiler during normal start-up from cold. Actually a reheater is merely an additional superheater which must be drained or boiled out, and protected from overheating, during the pressure-raising period when there is no steam flow through the tubes.

Before the fire is lighted reheater should be drained as completely as its design permits. Reheater drains that discharge to the condenser should be left open until the boiler load is 5 to 10% of full rated steam flow. Reheater

KNOCKS OFF SCALE IN 1½ SECONDS!





This automobile plant uses two BJ Hydropress Pumps for descaling. One pump services as many as 10 cabinets (with 5 operating at once).

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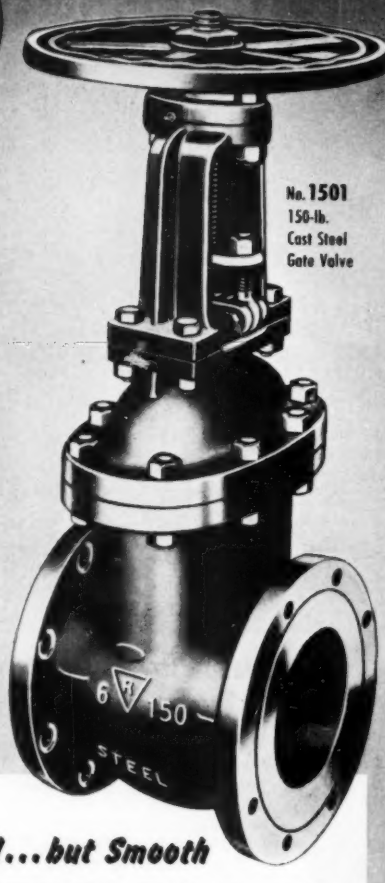

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More TECHNICAL BRIEFS

Begins on page 154

drains that discharge to the atmosphere should be left open until it is time to start the hogging jets of the condenser, then closed so air will not be drawn into the condensate system. If the reheater is non-drainable, any water that remains in the tubes must be boiled out during the starting-up firing period.

During the pressure-raising period, before there is steam flow through the reheater, gas temperature entering the reheater must not exceed 900 F. In most cases the similar restrictions on firing rate necessary to protect the superheater will provide adequate protection for the reheater.

Quick starting from hot bank. A high-pressure high-temperature turbine drops about 150 degrees F during a 6-hr shutdown. To minimize temperature differentials, steam temperature should be close to turbine temperature while the turbine is brought up to speed, synchronized, and loaded. It is not possible to deliver high-temperature, high pressure and reheat steam at the 30-50,000 lbs per hr required to roll the turbine at no load. So a temporary artificial load must be applied during the 15 minutes between putting the boiler on the line and loading the turbine.

The authors describe several working arrangements and outline other similar problems. *ASME paper. No. 51-A-80.*

Field Testing of Steam Sampling Nozzles. *By E B Morris, American Gas and Electric Service Corp.*

There's a general concept that the most important consideration in obtaining a representative sample of steam, aside from nozzle location, is that velocity of sample entering the nozzle ports equal the velocity of steam flowing past the nozzle. Lower than stream flow velocity should produce a sample of lower purity than representative, and conversely, higher port velocity should result in higher than representative purity.

This paper presents results of preliminary tests on evaporator vapor, conducted with sample nozzles of different design. These tests indicate what trends might be expected and attempt to determine the limitations in such testing with commercial evaporator installations. The tests cover only 2 types of nozzles for a specific upflow location. *ASME paper. No. 51-A-94.*

Water Treatment

Correlation of Silica Carry-over and Solubility Studies. *By C Jacklin and*

Indianapolis Power & Light Installing

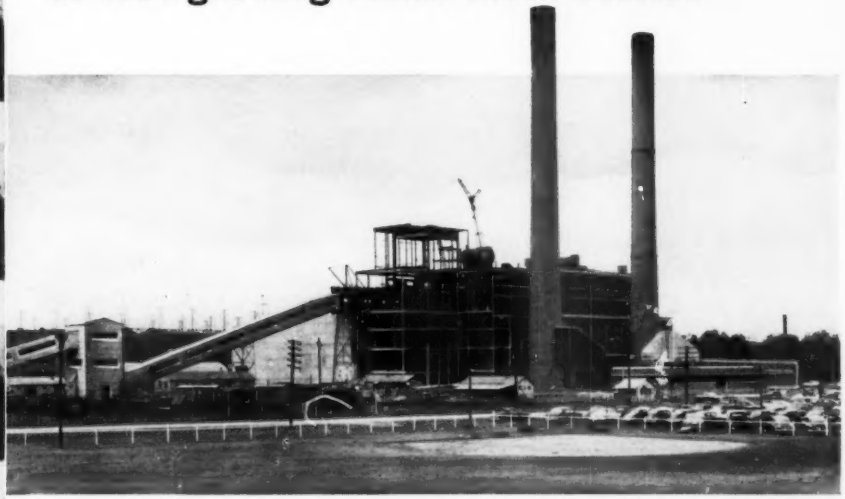
FIVE I-R RECTANGULAR CONDENSERS

at fast-growing White River Station

1949

1950

1951



1952

1953

OTHER I-R EQUIPMENT
in the Station
Boiler-feed pumps
Condensate pumps
Circulating-water pumps
plus many
smaller pumps

When the fifth turbo-generator goes on line, as scheduled for December 1953, the Indianapolis Power & Light Company's White River Station will have increased its capacity from 90,000 kw to 271,000 kw in less than four years. *All five* turbines in this station will be served by *complete Ingersoll-Rand condensing plants*—Rectangular Condensers, steam-jet ejectors, condensate pumps and circulating-water pumps. Gibbs & Hill, Inc. are the consulting engineers on this fast-growing White River Station.

The first two I-R Rectangular Condensers, each containing 30,000 sq ft of condensing surface, were installed in 1949 and 1950 to serve two 45,000 kw turbo-generators. The third condenser, now being installed, is identical and will serve a duplicate 45,000 kw turbine.

It was originally planned to add another 45,000 kw unit. But, because of the increased power demand, the fourth turbo-generator will have a capacity of 68,000 kw . . . due on line in 1952. It will be served by a 40,000 sq ft I-R Rectangular Condenser with complete I-R auxiliaries.

Unit No. 5, to be installed in 1953, will be another 68,000 kw machine, with a duplicate I-R 40,000 sq ft condensing unit. In addition, Ingersoll-Rand boiler-feed pumps and a host of smaller I-R pumps will be serving right along with all the condensing equipment.

Ingersoll-Rand Rectangular Condensers, like these five, save space and installation costs, because the rectangular shell is designed to *fit* the rectangular space available under the turbine. They are completely factory assembled and shipped *in one piece* or *in flanged sections* that can be bolted together without field fitting or strength welding.

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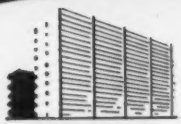

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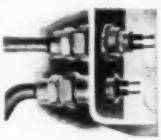

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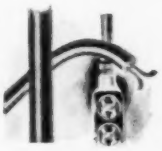

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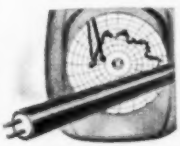

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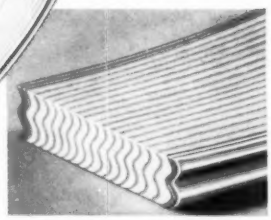

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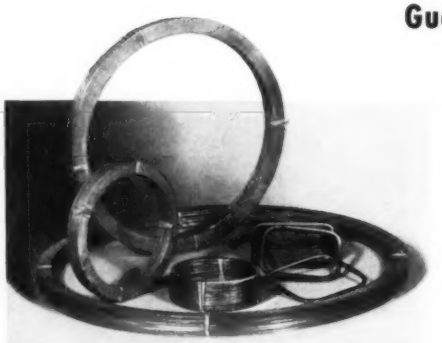

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Faced with rising fuel costs and declining efficiency of steam generating equipment, the management of The Michigan Paper Company of Plainwell had to decide whether to repair the present equipment or modernize the boilers and install new stokers.

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Detroit RotoGrate is an advanced spreader stoker with grates that move slowly forward to continuously discharge the ash at the front.

The Detroit RotoGrate Stokers at The Michigan Paper Company of Plainwell plant are paying big dividends.

Write for this complete story of the change-over described by T. S. Spicer, Associate Professor of Fuel Technology, Pennsylvania State College in Utilization Magazine. No obligation.

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THE STUFFING BOX is provided with gland, and the valve can be repacked under pressure when wide open.

SCREWED BONNET AND WEDGE DISC are standard on the Fig. 27 in sizes from ¼" to 3". Larger sizes are constructed with bolted bonnets and cam-type double discs with parallel seats. Working pressures ¼" thru 3": 125 lbs. steam, 200 lbs. WOG, non-shock. 3½" thru 6": 100 lbs. steam, 150 WOG, non-shock.

KENNEDY Fig. 27, Bronze Gate Valve, 125 lbs. steam, 200 lbs. WOG, non-shock

TO SAVE TIME AND TROUBLE, the Fig. 27 is *job-fitted* for easier installation, too. Wide, heavy pipe-end hexes have generous chamfer and precision threading . . . help you make tight connections quickly and easily.

FOR BEST RESULTS and real economy, standardize on KENNEDY Bronze Valves, and the complete line of KENNEDY Iron Valves, Malleable, Cast-Iron and Bronze Pipe Fittings.

WRITE FOR CIRCULAR 102 . . . BUY FROM YOUR LOCAL DISTRIBUTOR

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

Est. 1877

VALVES • PIPE FITTINGS • FIRE HYDRANTS

More TECHNICAL BRIEFS

Begins on page 154

S R Browar, National Aluminate Corp.

Experimental boiler studies show effects of different boiler water constituents on silica carryover from 400 to 4000 psi. They point up a need for clarification of the problem of selective silica carryover and deposition on steam turbines. The authors suggest a method of calculating silica solubility in saturated steam. They establish a correlation between results of geological studies of silica solubility at high temperatures and pressures, and silica deposits on steam turbines.

When they plot silica solubility against density of water and steam, the correlation shows between geological studies of silica solubility in steam at high temperatures and silica solubilities in turbine deposits. *ASME paper. No. 51-A-91.*

Directions for ordering papers on p 156

Spectrophotometric Determination of Small Amounts of Soluble Silica in Water. *By H E Robison, E A Pirsh and E Grimm, Armour Research Foundation of Illinois Institute of Technology.*

Reports on determination of silica in steam condensates and boiler waters sensitive to 0.01 ppm. Using the reduced silicomolybdate complex, and measuring color by a spectrophotometer at a wave length of 815 m. is recommended. Silica-free reagents, 100 mm cells in the spectrometer and optimum color development permit sensitive analysis for silica in the 0.01 ppm concentration range. The influence of pH on color progression, characteristics of the complex, and elimination of phosphate interference, is also described. *ASME paper. No. 51-A-92.*

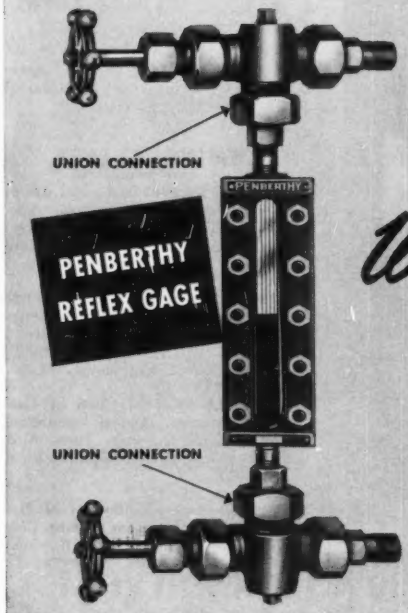
More POWER NEWS

Begins on page 152

Other papers presented at the convention were:

Combustion and Flue Gas Analysis, by Orval W Riggs, application engineer, Hays Corp; *Coal Analysis,* by E Baltzer, engineer, Dept of Mines and Technical Surveys, Ottawa; *Power Plant Piping Design* by F G S Williams, mgr, engineering standards, Taylor Forge & Pipe Works; *Ammonia Reciprocating Compressor Refrigeration,* by A W Heintz, ammonia specialist, Carrier Corp; *Preventive Maintenance,* by J M Hales, mgr, renewal parts apparatus department, Canadian General Electric Co; *Quality of Leadership for the Executive Engineer,* by Dr Herbert Moore, Psychological Service Centre, Toronto; *Power Plant Piping Problems,* by G W

PENBERTHY Liquid Level Gages



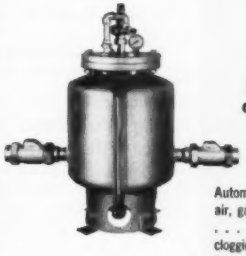
YOU CAN *Remove and Replace Without Shutdown*

Union connections between the gage and the valves permit removal of gage for repairs without shutting down the equipment. Just close the valves, uncouple the unions and remove the gage. The convenience of this is obvious. When glasses have to be replaced or repairs made, it is not necessary to work in an awkward position or to shut down. Another advantage: a gage needing repairs can be replaced immediately by a spare and the repairs made at leisure. There are many other reasons for the superiority of Penberthy Liquid Level Gages; ask for Catalog 35.

OTHER PENBERTHY PRODUCTS

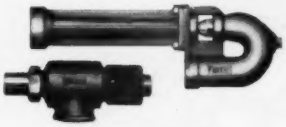
PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction—liquid chamber machined from solid block of metal. Ask for Catalog 35.



PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS

Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

4672

PENBERTHY INJECTOR COMPANY

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

FOR RELIABLE, ECONOMICAL POWER

A MIDWEST REFINERY installed... BOILERS BY BIGELOW

Bigelow Types F, FH and FHC boilers are available in capacities from 20,000 to 100,000 pounds of steam per hour. Design pressures range from 160 to 450 lbs. p.s.i. These boilers are designed for oil, coal, gas or combination oil and gas firing.

For further information on any of the boilers listed write for free catalogs or contact your nearest Bigelow representative.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types

Horizontal Return Tubular Boilers • Scotch Type Boilers

Two-Pass Boilers • Electric Steam Generators

One of the two Bigelow Type FHC Boilers installed recently at a midwest refinery. Installation is semi-outdoor with the firing fronts of the boilers inside the building.

Capacity — 40,000 lbs. each. Design pressure 250 lbs. Fired by combination #6 oil and gas burners. Boiler furnace side walls are completely water welded. Setting is tile, insulating block and [illegible] casing.

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8-8

MORE POWER NEWS

Begins on page 152

Hauck, mgr, engineering sales, Crane, Ltd; *Electronic Controls in Industry*, by L R Douglas, apparatus specialist, Canadian General Electric Co.

Present plans call for holding the 1952 convention for two days only sometime during October at the General Brock Hotel, Niagara Falls, Ont.

COMING EVENTS

Feb 7-8—Instrument Society of America, New York section, power plant symposium, Hotel Statler, N.Y. Richard Rimbach, chairman, 551 5th Ave, New York 17, N.Y.

Feb 28-29 — Pennsylvania Electric Assn, Prime movers and electrical equipment committees, Benjamin Franklin Hotel, Philadelphia, Pa. E Gordon, chairman, Potomac Edison Co, Hagerstown, Md.

March 10-14—National Assn of Corrosion Engineers, Annual conference, Buccaneer Hotel, Galveston, Texas. A B Campbell, Executive Secy, 919 Milam Bldg, Houston, Texas.

Mar 24-26—American Society of Mechanical Engineers, spring meeting, Univ of Washington, Seattle, Wash. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N.Y.

Mar 25-28—American Power Conference, Hotel Sherman, Chicago, Ill. Meeting chairman, R F Budenholzer, Illinois Institute of Technology, 3300 South Federal St, Chicago, Ill. Exhibit director, A F Thompson, 176 W Adams St, Chicago 3, Ill.

April 7-9—American Society of Lubrication Engineers, seventh annual meeting, Hotel Statler, Cleveland. J L Finkelmann, chairman, Warren Refining and Chemical Co, 750 Prospect Ave, Cleveland 15, Ohio.

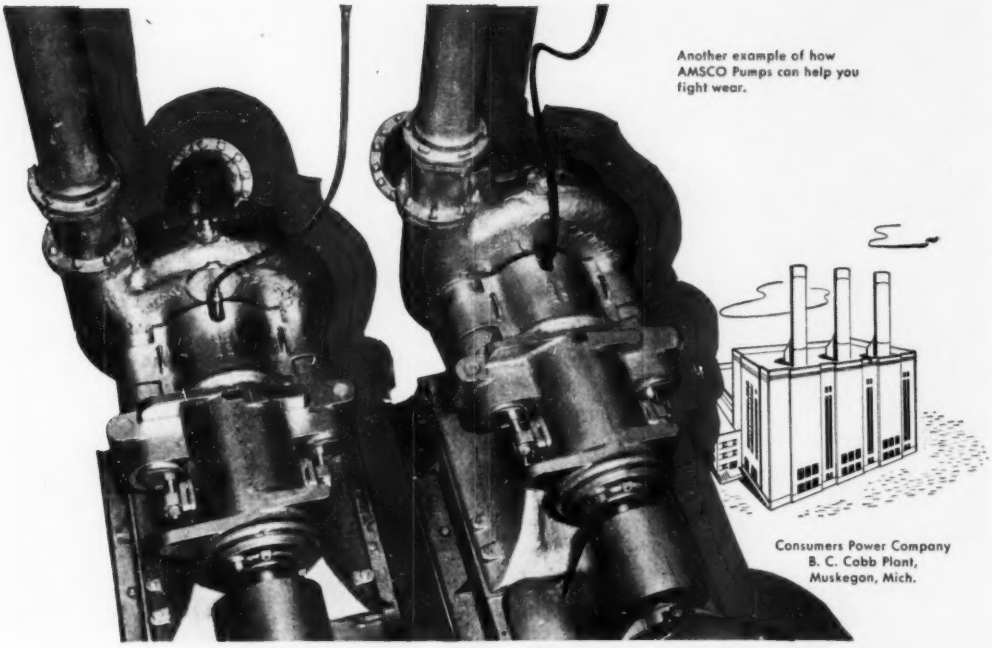
April 14-18—Oil Heat Institute of America, 29th Oil Heat Exposition, Exposition Hall, Philadelphia, Pa. R H L Becher, mgr, OHI, 6 East 39th St, New York 16, N.Y.

Big Hydro Power For British Columbia

Dominion government engineers are studying a hydroelectric project in British Columbia, Canada that will develop 375,000 to 750,000 hp. Present plans call for a dam 650 ft high at a site on the Columbia River 90 miles north of Revelstoke. The dam will back up the water 40 miles in a narrow gorge below Mica Creek.

British Columbia engineers are investigating a hydro site 170 miles from Vancouver on the Fraser River near Moran. It will develop more than 1,000,000 hp.

The Consolidated Mining and Smelting Co of Canada has started work on a 200,000 hp hydroelectric development on the Pend Orville River near Trail, B.C. Project has a concrete dam 210 ft high.



Another example of how AMSCO Pumps can help you fight wear.

Consumers Power Company
B. C. Cobb Plant,
Muskegon, Mich.

They lick their weight in ashes...4 times a day!

These AMSCO Pumps have handled 30,000 tons to date—without a replacement!

A walk through a new and modern power plant such as Consumers Power Company's B. C. Cobb plant at Muskegon, Michigan, leaves a strong impression that nothing was overlooked in designing for efficient power generation. That's why the familiar name "AMSCO" on the ash handling pumps is so significant . . . because these pumps were specified and installed by engineers who deal in cold facts . . . facts on past performance and current specifications.

Two AMSCO Pumps—working side by side for the past 2½ years—have pumped well over 30,000 tons of highly abrasive ash *without a single replacement to date.* Maintenance is simply a matter of routine inspection, consistent with good power plant management.

Any power plant can depend on AMSCO Pumps delivering this kind of trouble-free, economical performance . . . because working parts of tough, wear-resistant Manganese Steel are precision made for high efficiency and low disposal costs per ton. And, hundreds of successful installations in the past 30 years prove it!

WHENEVER YOU PUMP MATERIALS THAT CAUSE IMPACT AND/OR ABRASION . . .

. . . find out about longer-lasting, dollar-saving AMSCO Pumps. There's a size and type for every type of materials handling service . . . made by the world's largest producers of Manganese Steel castings for all industry.

AMSCO controls impact and abrasive wear in 5 basic industrial operations:

Brake Shoe **AMERICAN MANGANESE STEEL DIVISION**
382 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.

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FOAMGLAS is the only insulating material composed of millions of tiny glass bubbles containing still air. Still air is the world's best practical insulation. And glass, in this cellular form, has exceptionally high resistance to many elements that cause other insulating materials to deteriorate.

That is why FOAMGLAS, the only cellular glass insulating material, is such an effective, long lasting, economical insulation.

The eight features mentioned above are the main reasons for the rapidly increasing use of FOAMGLAS on hot and cold pipe lines and process equipment.

When next you figure on insulation, be sure to get all the advantages you enjoy only with FOAMGLAS. Send the coupon for sample and informative booklets.

Pittsburgh Corning Corporation
Dept. AT-22, 307 Fourth Avenue
Pittsburgh 22, Pa.

Please send me without obligation a sample of FOAMGLAS and your FREE booklets on the use of FOAMGLAS for Commercial, Industrial and Public Buildings ☐ Piping and Process Equipment ☐.

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APPOINTMENTS

Dr L C Marshall

Link-Belt Co appoints Dr Lauriston C Marshall director of its new physical testing and research laboratory, Indianapolis.

Dr Marshall is currently head of the microwave laboratory at the University of California (Berkeley), under joint sponsorship of the U.S. Air Force and the Research Corp. He is participating in the nuclear research program of the University's radiation laboratory for the Atomic Energy Commission, and during World War II was head of the radiation laboratory at M.I.T.

New general manager of Link-Belt's Colmar, Pa., plant is L J Carson, former gen mgr at Minneapolis.

Buffalo Forge Co elects two asst vice-presidents—Theodore M Dillaway and George B Kellogg.

Babcock & Wilcox Co names J H King to head its reorganized boiler div. Luke E Sawyer and Edward A Livingstone become company vice-presidents; M Nielsen is asst vice-president, assisting in operations of the boiler div.

Warren Steam Pump Co, Inc opens new district office at 6 Leonard St, Belmont, Mass. Parkman A Collins is dist mgr.

Weston Electrical Instrument Corp appoints Anthony H Lamb vice-president in charge of manufacturing. George T Deaney becomes gen supt of manufacturing, and Raymond T Pierce chief production supt. Philip Barnes is new director of the sales div; Hubert M Ricks gen sales mgr.

Allis-Chalmers Mfg Co names Charles R Martin in charge of manufacturing, production planning, and production control at Hawley Works. Henry F Banzhaf becomes asst to the manager, Hawley Works.

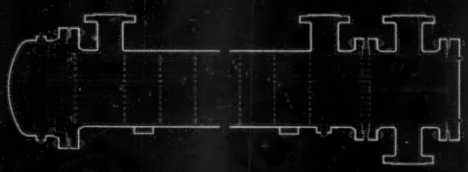
Flexrock Co exclusive representative in Kan., Neb., Okla., Ark., and western Mo., is Hinds & Associates, Inc, of Kansas City, Mo.

General Motors Corp promotes research laboratories personnel—Alfred L Boegehold becomes asst to the gen mgr; Dr Robert F Thomson becomes head of the metallurgy dept; Cleveland F Nixon heads the electro-chemistry dept. R E Waldo is new gen mgr of the New Departure div; John W Brophy is acting gen mgr of General Motors Diesel, Ltd, London, Ont.

Westinghouse Electric Corp names H H Hanft asst to the mgr of the industrial dept, and promotes Joseph H Cox to engineering

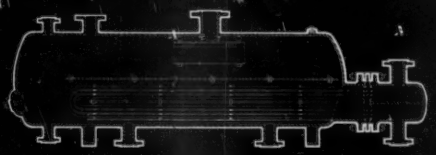
for HEATING

for COOLING



for CONDENSING

for EVAPORATING



for EVERY Heat Transfer application

. . . SUPERIOR HEAT EXCHANGERS meet the widest possible range of application. They find their greatest use in power plants, oil refineries, chemical processing and industrial plants. Superior's basic components . . . heads, shells, and tube bundles . . . make possible combinations to meet the requirements of any heat transfer application.

Our engineering staff invites your inquiry regarding any proposed application . . . as a basis for a specific engineering recommendation. Write for catalog 501.

for performance you can **BANK** *on*

SUPERIOR

HEAT EXCHANGERS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

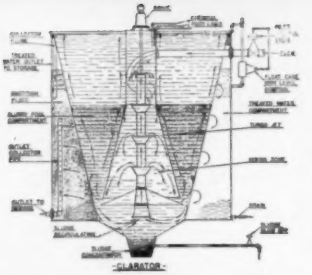
FOR CLARIFICATION, STABILIZATION NEUTRALIZATION, CHLORINATION PURIFICATION, ALKALINITY REDUCTION SOFTENING, SILICA REMOVAL, IRON REMOVAL, CONTROLLED CONDITIONING

The Belco CLARATOR

Advantages:

1. RAPID CHEMICAL SLUDGE CONTACT
2. SIMPLICITY OF OPERATION
3. VARIABLE OUTLET FLOW
4. SEPARATE STORAGE COMPARTMENT
5. COMPACT
6. AUTOMATIC CONTROL
7. LOW TURBIDITY

Looking into Belco Clarator



Essential Components of the Clarator:

1. Raw water inlet pipe
2. Automatic Desludger
3. Central mixing compartment
4. Overflow flumes
5. Turbo-Jets
6. Sludge concentrator
7. Treated water compartment
8. Axial flow slurry recirculation pump

The Belco Clarator is designed to handle all types of water treating problems. Essentially the process design of the Clarator and unit operation is identical for all problems. The differences lie in the type and quantities of chemicals used to achieve a definite treated liquid effluent. The raw water enters the mixing compartment at the top of the Clarator with automatically fed dosages of chemicals so that chemical reaction takes place immediately. Slurry particles rapidly grow in size by accretion and pass to the slurry compartment. The treated water flows around the perimeter of the tank to the outlet. Heavy particles of sludge collect and settle at the bottom of the concentrator where it is automatically discharged.

Complete description and color illustrations in Bulletin 108. Ask for your copy.

Belco engineers are prepared to give you authoritative assistance and close cooperation on all water treatment problems.

Belco

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
PATERSON 3, NEW JERSEY
Processes for Removal of Water Impurities

Belco Clarator installed in New York City for clarifying East River water.

MORE APPOINTMENTS

Begins on page 210

mgr of the Sunnyvale, Calif., plant. Wm P L'Hommedieu, asst mgr of the Pacific Coast dist, retired Dec 31.

U. S. Rubber Co, Naugatuck chemical div, appoints Clayton F Ruebensaal commercial development mgr; Dr D Lorin Schoene becomes mgr of plastics development.

General Electric Co announces that Edward A Green is mgr of product planning of the small and medium motor dept. Neil Currie, Jr, gen consultant for the manufacturing services div, has retired. Charles E Reed becomes gen mgr of the newly formed silicone products dept in Waterford, N. Y., and Richard T Walsh is supt of the Chemical div plant at Coshocton, Ohio.

Canadian Johns-Manville Co, Ltd appoints J O Eby mgr of the Jeffrey mine at Asbestos, Quebec.

Minneapolis-Honeywell Regulator Co names W L Gustafson power industry sales mgr west of the Mississippi river.

Nordberg Mfg Co establishes a branch office at 2520 Westlake Ave, N, Seattle, Wash, acquiring all sales and service facilities of the former Al-Pac Engine & Equipment Co. Carl S Harris becomes mgr of the new operation.

Norton Co appoints Frederick J Benn field engineer in the Cleveland area. C John Sundberg is appointed asst to the vice-president in charge of sales for the abrasive div; Stephen Smith becomes supervisor of the Worcester sales office; Frank W Smith, vice-president in charge of grinding machine div operations, retires.

Electric Products Co announces that Dr Wm A Thomas has joined their engineering staff.

Aluminum Co of America has a new director of research—Dr Kent R Van Horn. He succeeds Dr Francis C Frary, founder of organized research in the aluminum industry and organizer of the aluminum research laboratories at New Kensington, Pa., who is retiring.

Byron Jackson Co has entered into an escrow agreement to purchase the assets of the A D Cook Pump Co at Lawrenceburg, Ind.

Dearborn Chemical Co adds Wm A Tinsler, Jr, to its sales staff.

Youngstown Sheet & Tube Co appoints A A Hare Pittsburgh dist sales mgr, succeeding G B Strausner, who retires.

Yale & Towne Mfg Co appoints James H W Conklin gen sales mgr of the Philadelphia div, succeeding James P Kinney who takes over the distributorship in Los Angeles and Southern Calif.

Gifford-Wood Co appoints Walter G Engler gen sales mgr, succeeding the late Wm E Herb.

Republic Flow Meters Co opens new factory branch and district offices as follows: 2426 W Holcombe Blvd, Houston.

(*Continued on page 240*)

ALL JOY!

OIL-FREE COMPRESSORS

VACUUM PUMPS and BOOSTERS

Right above: Five JOY WNO-112 Oil-Free Compressors for pressure-testing of food containers, oil-free ejection of metal stampings, paint spraying and general oil-free processing service.

Left foreground: Three JOY WGV-9 Vacuum Pumps handle the job of vacuum feeding of metal sheets.

Left background: These three JOY WGB-9's boost gas pressure for the burners in the soldering process.

W&D 1-4016

giving highly satisfactory service in a large Midwestern Can Factory

For dependable *oil-free* air, day in and day out—as you may need it for any chemical processing or other special operation, or on that exacting instrument control job—there's a JOY OIL-FREE Compressor to meet your particular requirements. Dual Cushion valves, surface-hardened wearing areas and replaceable wearing parts are some of the exclusive JOY design features, and there's a complete line from 163 to 8800 CFM at pressures up to 100 PSI. A complete line of standard Compressors, Vacuum Pumps and Booster Compressors, too, for many different needs. Write for complete information, or . . .

Consult a Joy Engineer

Over 100 Years of Engineering Leadership

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GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY SULLIVAN OF CANADA, LIMITED, GALT, ONTARIO

Get this *SMALL* TRAP

With

BIG TRAP quality features!

TEST
STRONG
OUTLET
INLET
DRAIN
• Renewable seat—easily removed for servicing.
• Strong's patented, wear-resistant Anum-Metl† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
• Oversized ports—increased capacity.
• Horizontal inline connections—simplifies piping.
• Stainless 18-8 high ratio leverage.
• Large gasket area.
• Seamless, deep drawn, stainless 18-8 bucket—no welds.
• Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today for Catalog 68-P:

*T. M. Reg. U. S. Pat. Off.

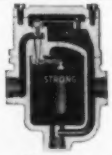
STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†Anum-Metl Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve



Blast Trap

Strainer

STRONG

MARMADUKE

Continued from page 146

pitched in to help my fireman and oiler. Everyone worked at fever pitch. The engine was rolling along and the thresher blowing out a mountain of straw and dust. There was no stopping for lunch. And the heat was terrific. Must have been 100 in the shade, but there's no shade in a wheat field.

"The boss came around on his horse after a while. He was boiling mad. 'We lost a couple hours getting started with your monkeying around,' he yelled. 'I asked you to start her up and not build me a new boiler.'

"I didn't argue. An engineer's first job is to know that his boiler is safe. It's too late after she blows up. Even at that, I had warmed her up too fast.

"Things hummed along at breakneck speed until about three o'clock that afternoon. Then the water glass burst. I looked in the tool box but there was no spare glass. With no try-cocks, I stopped firing and let the threshing machine work off most of the pressure.

"The boss galloped up on his horse and wanted to know why in hell I held up the show this time. I told him. That's when he really blew a gasket.

" '*I've been threshing long enough to know you don't need a gage glass or try-cocks to run a boiler,*' *he yelled. 'I can show you where the water level is—and I ain't no engineer,*' *he croaked.*

"You won't believe this," continued Marmaduke, looking at his audience over his shoulder, "but that guy grabbed a burlap wheat bag, soaked it in water and held it against the boiler shell where the water level normally was. Then he pulled it away quickly. For a split second there seemed to be a line, showing the water level. I knew this line was caused because heat transfer through water is about ten times that of transfer through steam. So the moisture left on the shell from the wet burlap evaporated faster opposite the water than it did opposite the steam, although both steam and water had exactly the same temperature.

" 'There's your water line,' the boss gloated. 'Now get that steam pressure up there again and let's get going.' Then he added triumphantly, 'That's the way we farmers engineer out here when we get in a pinch.'

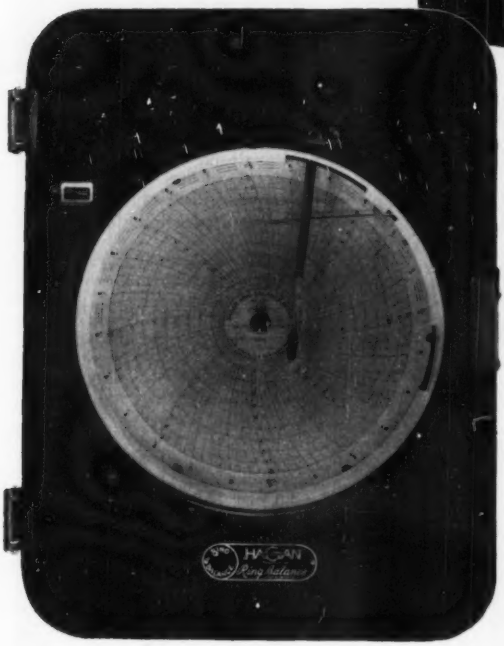
"But that was the last straw for me. 'Just pay me off,' I informed him, 'because I'm leaving this infernal machine as fast as my legs can carry me.'

" 'How come,' stammered the boss, surprised as all hell.

" 'It's because I'm crazy like Mark Twain,' I answered. 'I came out here for my health—and I'm leaving for the same reason.' "

No stuffing box troubles in

HAGAN RING BALANCE METERS



because there are no stuffing boxes!

Forget about stuffing box troubles and pressure tight bearings when you install Hagan Ring Balance Meters. The simple, flexible S-tube connections to the ring assure dependable accuracy and trouble-free operation.

Features of the Hagan Ring Balance Meter include:

- **Calibration can be checked under operating conditions by check-weight method**
- **Excellent response at extremely low flow rates**
- **Mercury level not critical**
- **Full-scale chart differential is adjustable over a 7-to-1 range**

HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

Our engineers will be glad to show you how Hagan Ring Balance Meters can help solve your metering problems. Use the coupon, or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

Hagan Corporation
Hagan Building • Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

.....

NAME .....

POSITION .....

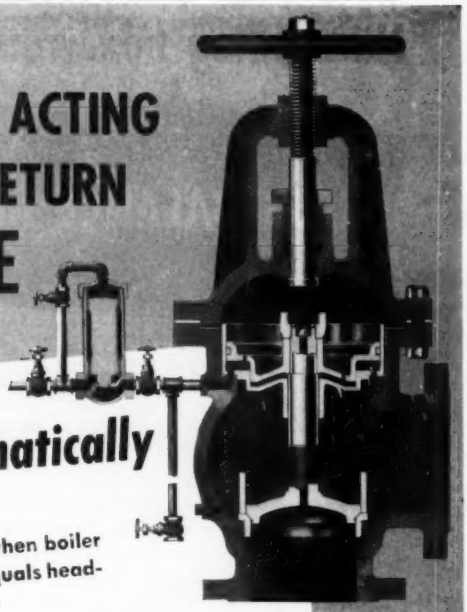
COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

P-2

This
TRIPLE ACTING
NON-RETURN
VALVE



Automatically

✓ **Opens** when boiler pressure equals header pressure

✓ **Isolates** and prevents back steam flow into a defective or lower steaming boiler

✓ **Prevents** boiler steam flow when steam line or header is ruptured.

GOLDEN-ANDERSON

also makes this Single-Acting Non-Return Valve

which will automatically open to cut-in the boiler when its pressure equals the header pressure and automatically close to isolate the boiler when its pressure decreases.

Bulletins S-1A and S-2 contain complete technical data.

GOLDEN ANDERSON Valve Specialty Company

2070 KEENAN BUILDING • PITTSBURGH 22, PA.

WATER SOFTENERS

Continued from page 87

power and has to give way to the exclusive use of dolomite or the other magnesium silica-correctives.

So as not to undo the good of the lime softening, the filter that follows must have a nonsiliceous bed, preferably of graded, crushed, anthracite or iron ores. In the cold process the acid treatment and degasification steps precede the zeolite softener. To cut down on the costs of these intermediate steps you'll frequently find relatively cheap sulfuric acid and miniature forced-draft cascade towers employed.

Recently marketed, specially prepared resinous sodium zeolites prove particularly useful following filtration of a hot lime-dolomite effluent. Unlike the normal carbonaceous zeolites these new resins resist both the relatively high pH and temperatures of this effluent. The regenerating brine for these special zeolites gives the most uniform and highest efficiencies when it is held at about the mean temperature of the two softeners. For the special zeolites you hold off the acid treatment for control of boiler water's concentrating alkalinities until after the zeolite step. Further, with the hot process (water above 200 F) acid-feed requirements generally run so low, degasification is seldom justified.

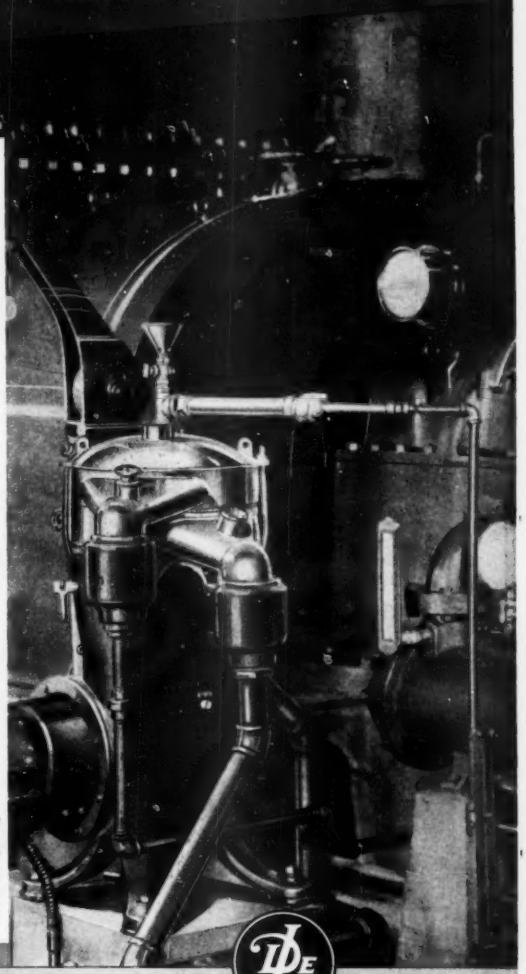
Hot Lime Soda, Phosphate. The only way to apply external phosphate softening is to use the hot process. Softening remains incomplete in the cold process and delayed precipitation of phosphate can produce dangerous deposits along the feedwater system.

With the combined hot-lime soda and phosphate softening your first stage must produce its maximum softening. This keeps later, costlier softening with phosphate at its lowest possible amount.

The lime-soda process fits in nicely for pre-phosphate softening. It not only extracts the greater part of the raw water's total hardness, it also furnishes the high alkalinity so necessary for full phosphate reaction on the remaining hardness. With the high alkalinity the remaining hardness is almost all unprecipitated calcium carbonate. The phosphate goes to work on this, Fig. 2, to remove it as tricalcium phosphate. This combination works best on raw waters with alkalinity fairly low to begin with. Otherwise, there's still a danger of developing too high an alkalinity at the boiler-water stage.

Suitable phosphate softening needs only 45 minutes' retention time against lime soda's full hour. Normally each procedure goes on in separate, adjacent units. If makeup runs quite low, both

The Great Advantage of De Laval By-Pass Centrifuging



De Laval centrifugal purification is the best possible means to keep lubricating oil clean. But even a De Laval machine will give better results on continuous by-pass than when used to purify "batches" of oil periodically.

Because De Laval by-pass purification is a continuous process, its advantage over "batch" methods is that any leakage of water to the lubricating oil system can be detected immediately. Any increase in the water discharged from the purifier, which is operated continuously, shows up at once. There is no chance for any dangerous amount of water to collect in the oil.

A De Laval Oil Purifier of proper size on continuous by-pass will clean all the oil in the system every six to eight hours. Obviously, the rate of purification depends on viscosity of the oil and the size and weight of the contaminants.

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4 Green Forced Draft Fans
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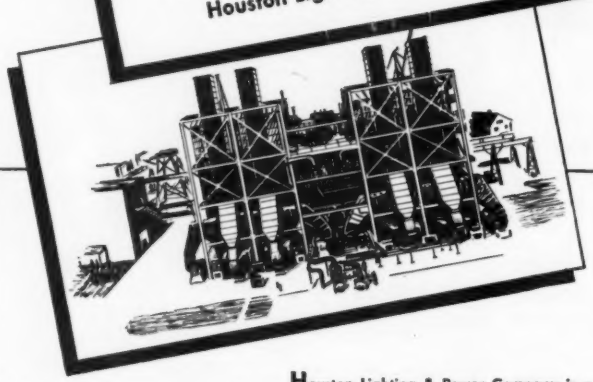
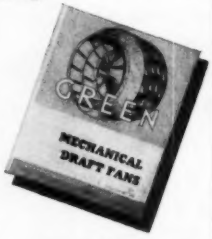
...Serve the West Junction Plant of
Houston Lighting & Power Company



Houston Lighting & Power Company is a leading factor in the power field of the great southwest. That it approved the selection of Green Draft Fans by the boiler manufacturer — in this case Riley Stoker — is evidence of high acceptance in the field. No utility can afford to operate with inferior or unsuitable equipment at any point. It must have equipment that is not only highly efficient but right.

To Houston Lighting & Power can be added other well-known recently completed utilities that are Green Fan plants, among them the following:

Central Hudson Gas & Electric Co.
Atlantic City Electric Co.
Virginia Electric & Power Co.
Monongahela Power Co.
Louisiana Power Light Co.
Kansas Gas & Electric Co.
El Paso Natural Gas Co.
Pacific Gas & Electric Co.
South Carolina Public Service Authority
Buffalo Niagara Electric Corp.



With utilities as with industrial power plants, it's safe to "Go on Green" when it comes to draft fans.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.
BEACON 3, NEW YORK
ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

WATER SOFTENERS

Continued from page 216

stages can be incorporated in one unit.

Disodium phosphate usually serves in the second stage. If a low feedwater alkalinity is needed, you can put monosodium phosphate or phosphoric acid to work without resorting to further acid treatment. But you'll find chemical costs considerably increased and softener control more difficult.

When it comes to selecting acid treatment, pick sulfuric acid. It serves two purposes: (1) reduces the alkalinity of the filtered, phosphate-softened water (2) converts unprecipitated calcium hardness into soluble sulfates, eliminating any threat of belated deposition in the feedwater line.

When acid treatment can't be justified, be sure to inject a surface-active chemical continuously, especially before an economizer unit. An organic compound of this kind can also help to coagulate the little hardness that precipitates out in the boiler.

Conclusions. Either the lime-soda and zeolite or the hot lime-soda and phosphate external softening systems can furnish a makeup water free of suspended matter, greatly reduced in soluble silica, virtually rid of its dissolved gases, softened to practically zero hardness—in short, qualities most suitable for fairly high boiler operating pressures. These systems furnish a means of successfully bridging the vast field of application between moderate and exceptionally high operating pressures—from the simple softeners to the demineralizers.

COMPRESSORS

Continued from page 95

these three types based on full loading of a 100-hp motor, air at 100 psi.

Look over Table II, and you'll see that justifying a more efficient compressor depends chiefly on load factor and current cost. The greater the load factor and current cost, the more advantageous is an efficient compressor. Maintenance and depreciation have been neglected in the table.

What Price Water? Where water cost is high, you may be wise to go to an air-cooled unit even though load factor is high. In Table II with a load of 258,000 cu ft per day the savings of $520 per year shown by the two-stage watercooled unit would be wiped out by a water cost of 37¢ per 1000 gal. Plants needing process water, unless its cost is negligible, find it profitable to use tepid water coming from the com-

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These great condenser tubes have enough antimony to resist dezincification. And, in addition, antimony is one inhibitor that will not weaken the tube. The metal starts with the right grain structure and retains it . . . it stays tough and withstands the stresses of heavy duty assignments.

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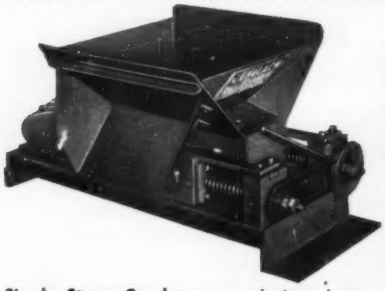
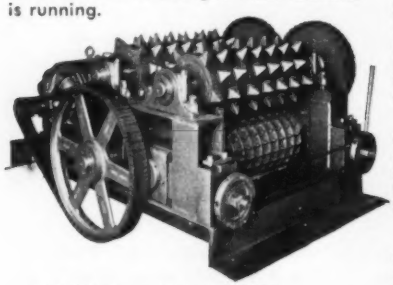
3 CRUSHERS designed to meet YOUR NEEDS



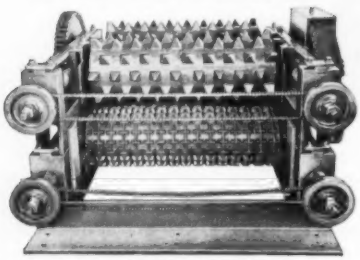
Close association with the coal industry has enabled Gundlach to develop a line of Crushers which fulfill an urgent need in this industry. Rugged, simple construction combined with engineering proved in the field make these machines profitable and reliable units.

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

Single Stage Crushers . . . designed to crush nut to stoker, 2 inch to stoker, 4 inch to nut, or any other job where 2 stages of crushing are not required. Material size can be changed while machine is running.



TWO STAGE — SINGLE ADJUSTMENT



TWO STAGE — DOUBLE ADJUSTMENT

MAINTENANCE The contact portions of the balanced steel crushing rolls are hard-faced and can be built up readily. Economical maintenance adds to your profit by reducing downtime on the machine.

GEARS AND BEARINGS All gears are steel cut and run in oil, assuring durability and long wear. All bearings are Timken roller bearings, easily accessible for lubrication and maintenance.

CONTROL AND POWER The GUNDLACH CRUSHER can be furnished in electric, gasoline or diesel power unit to fit any installation. Specifications for these power units will be furnished on request. In electrical installations the power is controlled from a switch panel allowing the crusher to be reversed to eject material which may temporarily jam crushers.

DRIVES Maximum power delivery from the motor unit is achieved by a silent chain or "V" belt drive. The "TWO STAGE" crusher rollers are driven by steel cut gears. Rollers are protected by spring loaded travelers.

Two Stage Crushers . . . incorporate two stages of crushing in one machine and are designed to crush run-of-mine coal from ½" to 2" (Single adj.) and ½" to 6" (Double adj.) in one operation. Material size can be changed while machine is running. Crushers are shown without hoppers or sprocket guards but are delivered complete.

WRITE FOR CRUSHER BULLETIN P

T. J. GUNDLACH Machine Co.

BELLEVILLE, ILLINOIS

COMPRESSORS

Continued from page 218

pressor. Table III, below, shows usual water quantities needed for various parts of the compressor.

III: COOLING WATER NEEDED FOR AIR COMPRESSORS*

	Gal per 100 cu ft of free air
Separate intercooler	2.5-2.8
Intercooler and jacket in series	2.5-2.8
2-stage jackets alone (both)	0.8
Single-stage jackets:	
40 psi	0.6
60 psi	0.8
80 psi	1.1
100 psi	1.3

*From *Compressed Air Handbook*, published by Compressed Air and Gas Institute.

Unit Control. Compressor controls are like the reins on a horse. They permit you to regulate output to load. We won't go into every type of control, but there are certain general principles helpful to prospective purchasers of air compressors.

Compressors of 100 hp and less can use one of three types of control. With continuous use of air, constant-speed control does a fine job. Compressor runs unloaded when cutout pressure is reached. Unit is reloaded when pressure falls to cut-in point. This is usually 10% below the cutout pressure. Suction valves of compressor are held open during unloading, allowing fresh intake air to swish in and out of the cylinder. Unloaded period seldom lasts more than one minute because air demand is continuous. So there is little to justify bringing the rotating and reciprocating mass of moving parts to rest only to restart them immediately.

Start and Stop. Where there are long intervals without air demand from system, automatic start-and-stop control is used. It works much like the control on a domestic refrigerator. Chief disadvantage is that range between starting and stopping pressures must be about 20% of cutout pressure. This wide pressure variation may interfere with uniform performance of air-operated devices.

Dual Control. This control combines constant-speed and automatic start-and-stop. It's the most economical and insures good operation of air-driven devices. You can switch manually from constant-speed to start-and-stop. Thus compressor runs at constant speed during rush hours, start-and-stop when air demand is low or infrequent.

Step Control. Above 100 hp, compressors are fitted with step control, so unit automatically adjusts itself to air

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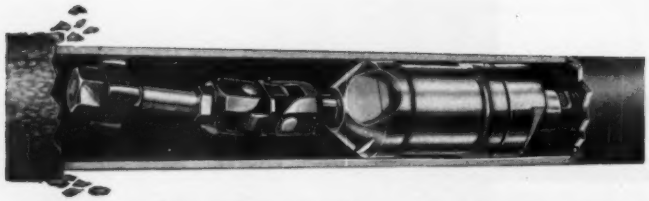

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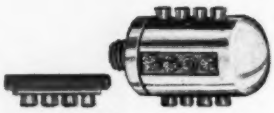
INSIDE and OUTSIDE

You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

Try the new Rotojet, and no other tube cleaner will ever satisfy you.

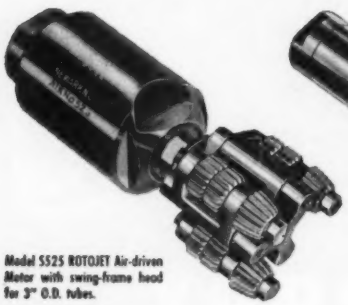
Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.



Model S525 ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model S505 ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.

COMPRESSORS

Continued from page 220

demand. Three-step control (full, half and zero load) gives variation in output to meet any demand. Five-step control (full, three-quarter, half, one-quarter and zero load) is a further refinement that is practically universal in compressors of 150 hp or more. Over-all efficiency is maintained even at fractional loads, particularly with synchronous-motor drive, because motor has a relatively flat efficiency curve.

Other Controls. For those who like special controls, compressors may be fitted with several types. Automatic shutdown devices can be put in the control circuit to stop the compressor dead in its tracks if cooling water rises above a preselected temperature. Or they will do the same if lube-oil pressure gets too low or too high, if discharge temperature rises above a safe value, if a main bearing becomes overheated, or even if total power demand in the plant reaches the peak on which demand charge is based.

Six Easy Steps. With these facts in mind you're ready to make an intelligent selection of a new compressor. Just (1) estimate total air demand in terms of cu ft per day; (2) find actual capacity in cfm needed to meet maximum sustained demand (better add 20 to 30% to this figure to provide for leaks and new demands); (3) find annual power cost for several compressor types; add water cost; (4) decide which compressor type will give lowest air cost for the job. (5) Select control best suited to job demands. (6) Place your order for the compressor.

EXTRACTION TURBINES

Continued from page 93

equipped for firing with oil or gas to supplement the byproduct waste.

Turbine control could be arranged to maintain constant kw output at essentially constant speed with any of the following methods of operation:

1. Maintain pressure in waste-heat boilers with admission at h-p control stage and satisfy extraction demands at both intermediate-pressure (i-p) and l-p controlled stages, while maintaining pressure in these stages. Fig. 5 is specifically arranged for this method of operation.

2. Zero extraction at either or both l-p and i-p extraction stages.

3. Zero extraction or admission with sufficient h-p boilers available or waste-heat boilers supplemented by oil firing when necessary to satisfy kw load demand.

This turbine could also run strictly

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RIGHT SPECIFYING
In The Beginning Prevents
POST-INSTALLATION HEADACHES

TELL YOUR PUMP SUPPLIER *Everything About the Job!*

● Since every pump is designed to perform best under certain conditions, send along a complete description of the expected conditions when sending requests for quotes.

This should include:

(1) *Description of the liquid:*

temperature, corrosive and/or abrasive characteristics, specific gravity, viscosity and vapor pressure under service conditions, and if possible, a chemical analysis. This enables the supplier to recommend the right trim, also the right type and design of pump for the job.

(2) *Capacity—both operating and maximum—in gallons per minute—*

so that a pump may be selected within the range of highest efficiency, yet the sufficient margin for safety.

(3) *Type of drive (direct or belt), and type of driver (engine, turbine, motor)*

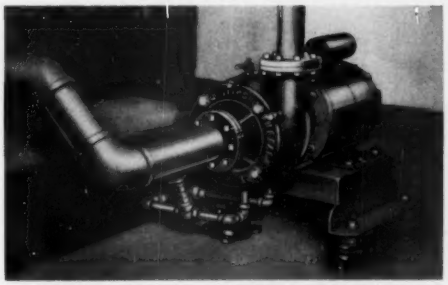
(4) *Discharge pressure or head of liquid to be pumped.*

(5) *Suction left or suction head.*

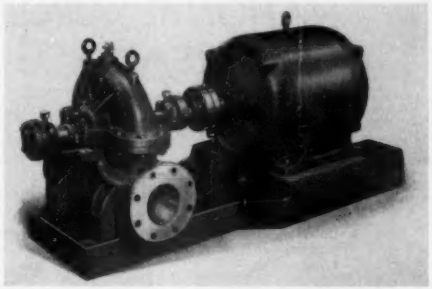
Complete information assures your getting the right pumps and often enables the manufacturer to suggest an alternative which might be cheaper and more efficient. "Buffalo" engineers will be happy to give you helpful advice on selecting the best pump.

10 to 10,000 GPM SIZES in these rugged, efficient pumps. Double-suction, they are hydraulically balanced. "Buffalo" Pumps can be had for heads up to 300 feet. Bulletin 955-P, giving all specifications, is yours on request.

TO OPERATE AT HEADS UP TO 1500 FT. "Buffalo" Type "RR" Clear Water Pumps are available in two-stage and four-stage models, for boiler feed service. Capacities up to 900 gpm. A highly efficient pump with plenty of ability to stand punishment on the job. WRITE FOR BULLETIN 980-B.



FOR CLOSE QUARTERS—the "Buffalo" Close-Coupled Pump is compact and sturdy for clear water service in a wide range of applications. Impeller mounted on motor shaft assures permanent alignment. Complete information in BULLETIN 975-B, yours on request—or contact your trained "Buffalo" representative in the nearest city.



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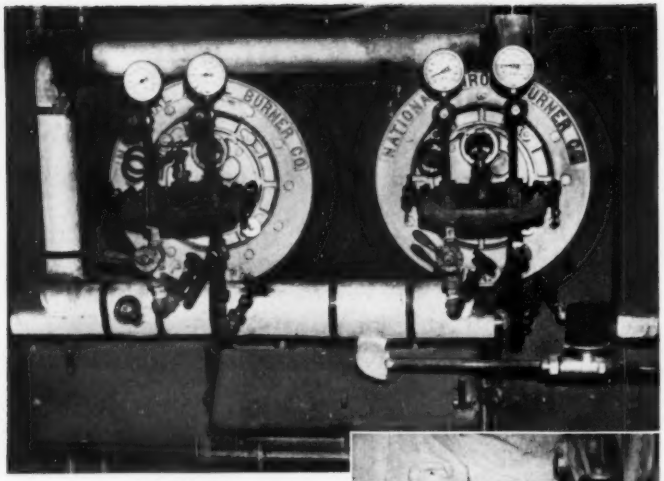

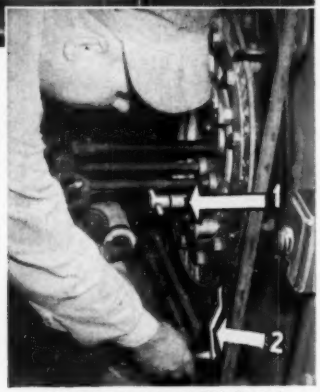

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(2) Air Vane Control

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EXTRACTION TURBINES

Continued from page 222

on waste-heat control where kw output would vary with waste-heat availability, with or without extraction.

Two Boiler Pressures. Fig. 6 would be suitable for a plant with boilers having two different pressures and process-steam demands at two lower-pressure levels. The turbine could be run to maintain constant kw output at essentially constant speed with any of the following methods of operation:

1. Straight speed control on h-p inlet flow to satisfy kw demand with zero admission or extraction.

2. Speed control with constant h-p inlet flow, i-p and l-p extraction demands satisfied, maintaining pressures at these stages, and admission at h-p control stage varying with kw load and i-p and l-p extraction demands. Fig. 6 is specifically arranged for this method.

3. Speed control with zero admission and h-p inlet flow varying with kw load, and i-p and l-p extraction steam demands.

4. Speed control with zero h-p inlet flow and total admission flow with h-p boilers out of service. Admission flow supplies kw load and i-p and l-p extraction-steam demands.

5. Speed control on h-p inlet flow with automatic pressure control on the h-p admission-control stage, and i-p and l-p control stages. This permits the turbine to control the pressure in the admission line and permit only the "available" steam to enter the turbine at the admission stage and reduce the steam needed from the h-p inlet boilers.

These three typical schematic arrangement diagrams show some of the flexibility that can be used to fullest advantage for plant operation. The diagrams are simplified, they do not show all the details of levers, pivots, relays, oil supply, etc. Each pressure governor and extraction can be locked out of service independently of the others. In addition, the speed governor can overpower any or all pressure governors to close valves on an increase in speed, and various relays can be made to overpower others as desired. Many arrangements can be designed to meet various needs as they arise.

DESIGNING STACKS

Continued from page 90

alone we favor a steel stack.

Further, a lined steel stack, from our experience, piles up fewer maintenance charges in a 20-40 yr period. It is free of any potential lightning damage. Corrosion and internal erosion

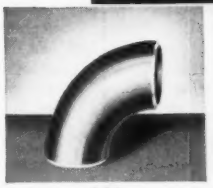
LOW RESISTANCE to FLOW

Minimum resistance to flow . . . that is the feature of Midwest Welding Fittings we call to your attention with this photographic fantasy. Other superior qualities that result from our unique manufacturing methods are dimensional accuracy and uniformity . . . true circular cross-section, controlled wall thickness, and accurate radius, included arc and tangents. The consequent benefits are a saving in welding time and a better piping system.

4581

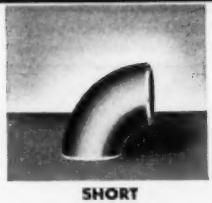
MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".



ASA STANDARD

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings, ASA B16.9. Tolerances much less than allowable. Sizes to 26".



SHORT RADIUS

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

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- Lower installation costs
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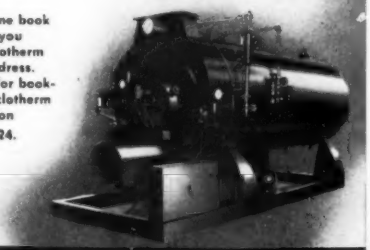
Boilers are designed for oil or gas operation from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

Your phone book will give you your Cyclotherm man's address. Or write for booklet on Cyclotherm Combustion to Dept. 24.



CYCLOTHERM CORP., OSWEGO, NEW YORK

DESIGNING STACKS

Continued from page 224

from flyash on unlined portions are its biggest maintenance enemies. You always have to keep such a stack painted.

Stack Linings. We're strong believers in the value of stack liners. They serve three valuable purposes: (1) protection of stack surfaces from corrosion and erosion; (2) maintenance of higher stack gas temperatures by insulating gas flow from relatively cold stack surfaces (higher temperatures give more buoyancy to the gas permitting plume to rise higher, disperse better); (3) cushioning stack surfaces from extremes of temperature changes, so strain and temperature cracking on cold-weather shutdown is greatly lessened.

Our linings have gone on in this way. We put in suitable holding studs and mesh on the steel-stack inner surfaces. Then apply the aluminite cement and haydite aggregate directly to a depth of two inches. These linings stay sufficiently intact and in close enough bond to the steel to avoid leakage of any gases between lining and steel.

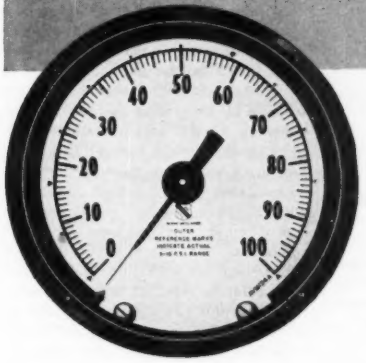
Crystal-Ball Design. Most everything up to now has been pretty straightforward. But today the stack designer has three imponderables—effect on atmosphere of stack discharge, height requirements as fixed by present and future Civil Air Authority restrictions, future developments in regulations as set forth by air-pollution control agencies.

Several of the larger utility companies have set up experimental wind tunnels. Models of new plants with proposed stacks to scale go into these wind tunnels. Then the prevailing wind conditions are duplicated in the tunnel and stack smoke discharge behavior studied.

As a result of these studies the dispersal pattern can be well established beforehand. With such a guide an acceptable stack height and exit velocity can be developed. It is only from such practical approaches that solutions will come to individual plant problems arising from atmospheric inversion. But even so you have to do a certain amount of guessing on what the future holds: (1) as far as stack discharge effect on the atmosphere goes and (2) regulations against it.

Similarly the present regulations of the CAA (Footnote 1, on p 88) on aviation limitations, airport proximity, glide angle can change.

In an uneven terrain or in an area where tall buildings may later be erected, a chosen stack height may need increasing, maybe as much as 50-60 ft. When it comes to making pro-



Duplex Receiver Duragauge—3½" Dial Size.
Peripheral pointer is red.

Compact panelboard design demands pressure gauges that combine extreme accuracy with smaller size, easy-to-read dials. *The new Ashcroft Receiver Duragauges, with 3½" dial, meet those requirements exactly.*

Wherever pneumatic transmission and control systems are used to indicate pressure, temperature or flow—in power plants, refineries, chemical plants—these new *Receiver* Duragauges provide *accuracy within ½ of 1 percent of the dial range.* Standard transmitted air pressure range is 3 to 15 P. S. I. Other ranges include 2 to 14, 2 to 15, 3 to 18 and 5 to 25 P. S. I.

Single and Duplex *Receiver* Duragauges are available. The Duplex incorporates two separate sets of Bourdon tubes, movements and pointers. Bourdon tube material is heat-treated phosphor bronze, extra wide for extreme sensitivity, with long tip travel for precision accuracy.

Get complete data, including dimensions and standard graduations. Your Ashcroft Distributor will gladly help you select the right *Receiver* Duragauges for your specific needs.

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BIDDLE

NUMBER 6 OF A SERIES

Instrument News

(Model 1B—Battery Operated Set)

FOR LOW-RESISTANCE MEASUREMENTS BETWEEN 100 AND 10,000 MICROHMS

Megger® Portable Low Resistance Ohmmeters

Self contained battery-operated and rectifier-operated types of Megger Low Resistance Ohmmeters have just been developed. They are designed for hard routine and emergency service in measuring contact resistance, such as in circuit breakers, relays, switches, bonds, connections and joints, commutator bar-to-bar tests and the like.

These portable instruments (weight 19 lbs.), are designed for low resistance measurements in the shop and in the field. They are of moderate cost and are accurate to within 1.5% of full scale deflection.

Model 1B operates from two 4 FH dry cells mounted inside the case.

Model 1R operates from a rectifier, built inside the instrument case, for connecting to 115 volts, 50-60 cycles.

Both models have a range of from .001 to .010 ohms. These new instruments operate on the same crossed-coil ohmmeter principle as the Ducter Low-Resistance Ohmmeter, with pointer indications of resistance and no necessity for balancing or voltage adjustment. Scales have fairly uniform graduations and are approximately 3¼" long. Anyone can operate this equipment—no special training or experience is required.

For particulars and prices write for Bulletin 24-46-P.

CABLE FAULT LOCATOR SCORES HIGH IN SAVINGS OF TIME AND MONEY

The BIDDLE IMPULSE CABLE FAULT LOCATOR combines a high-voltage capacitor discharge transmitter with a new type of detector to form a complete Tracer Current Set. This equipment has the advantages of high current and voltage output with small power input and is of moderate size, weight and cost. Also the use of this equipment is not restricted by networks or branches, and under certain conditions will even operate successfully without disconnecting transformers. Furthermore, the method of detection—which is the heart of the set—gives a positive indication of whether the fault has been reached or passed when an exploring pickup coil is applied at various points along the cable.

Equipment now in use has proved highly effective in utility and industrial service. It has made real savings for owners in both time and money. Upon written request on your company letterhead we shall gladly furnish names of users. The coupon below will bring you more details in Bulletin 65-P.

FREE REPRINT ON "CABLE-FAULT LOCATING PRACTICES IN PHILADELPHIA"

That is the title of an article which appeared in a recent issue of Electric Light and Power Magazine. It was written by R. S. Diggs, Assistant Superintendent, Service Maintenance Section, Philadelphia Division, Electric Transmission and Distribution Department of the Philadelphia Electric Company.

Mr. Diggs discusses the three methods of locating cable faults used on his company's underground power systems, the a-c method, the thyratron, and the impulse method.

We have obtained a limited supply of these reprints and will be glad to supply them to interested individuals so long as the supply lasts. Ask for Bulletin 65 P1-P on the enclosed card.

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visions for any such jump in stack height, costs go skyrocketing. Here's why.

Initial steel weight alone requires a heavier foundation design. Add to that the fact that a higher stack transmits a greater wind load on windward-side piling and a stronger uplift on lee-side piling. So you need a considerable mass of concrete to offset this effect and, therefore, more load piling. The only time you can prepare your foundation properly is before the stack goes up. If this basic thought could be better appreciated, then framers of regulatory legislation would be well advised in applying new regulations to old plants.

The drawing on page 88 shows some provisions you can put into a stack today that will always prove valuable. They include safeguards against flyash buildup, as well as a means of stack cleanout.

Stack lighting requirements are usually easy to meet but their maintenance is an entirely different matter. Future regulations should take this into account.

BETHLEHEM STEEL

Continued from page 99

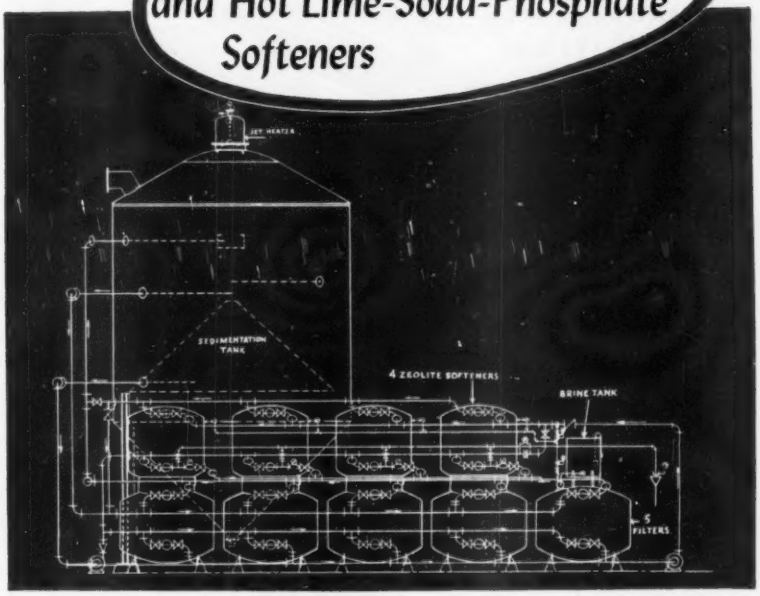
PRIMARY CABLE

Widely distributed transformer stations are arranged so several transformers are connected to the same line. Thus line No. 19 can be put into service as an emergency tieline between stations 6A and 6B by closing the 6B-19½ disconnects. Feed to each of stations is run in channels through the building. This feed is a 3-conductor, specially designed, 15-kv cable, No. 2/0-Awg, 37-strand, with 27/64-in. rubber insulation and tinned-copper shielding tape over each conductor. All three conductors are cabled together with jute, and covered with a double wrap of tape, a layer of saturated jute, two layers of 0.030x2-in. galvanized-steel tape armor, and finally a double wrap of duct tape over the armor to make painting easy. This cable and the channel, when it is so supported, have been painted yellow with red stripes. In addition, 13.8-kv signs are located about 25 feet apart over its entire length. These signs act as keep-clear warnings.

Naturally, cable must be carefully installed. Experience shows most cable failures are not in the runs, but at the cable ends. Entire installation (requiring insulated cable) was made with rubber-insulated, shielded cable. Varnished cambric or paper insulation was not used since many runs were vertical and oil migration could be a problem. Furthermore, in several cases, varnished cambric cable in ducts, which were

Cochrane HOT Lime ZEOLITE Water Softener

A Suggestion for Operators of Hot Lime-Soda and Hot Lime-Soda-Phosphate Softeners



The installation at the right shows a Cochrane Hot Lime-Zeolite Softener in a paper mill in the Northwest. The Zeolite Softeners are mounted on and supported by the filters in order to save space.

The introduction of Cochrane Hot Lime-Hot Zeolite Softeners presents an exceptional opportunity for increased capacity, with surprising savings in cost, to operators of conventional Hot Process Softeners who may be faced with expansion problems suddenly thrust upon them by today's production requirements. The conversion to Hot Lime-Hot Zeolite can be accomplished, in the case of Hot Lime-Soda Softeners by merely adding another settling tank to the existing settling tank, adding more filters, followed by a booster pump station discharging through a battery of Zeolite Softeners. In the case of two-stage softeners, the Hot Phosphate Tank is eliminated or may be used to double the first stage lime tank's capacity. More filters and a battery of Hot Zeolite units are added.

Cochrane Hot Lime-Zeolite Softeners are being installed in many expanding industries in all parts of the country.

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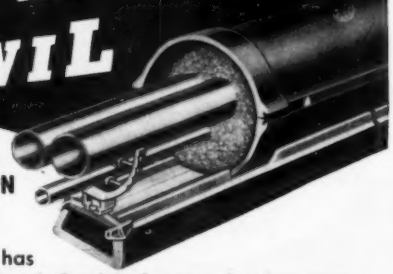

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UNIVERSAL TILE CONDUIT—with half tile arch, trapezoidal side blocks, and concrete foundation.

Don't make the mistake of accepting inferior, poorly-designed and rank imitations of the original Ric-wiL Sectional Systems. Make sure you specify "RIC-WIL"—preproved by thousands of installations—and know that you are getting the BEST.

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PREFABRICATED INSULATED PIPING

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PREFABRICATED MANHOLES

UTILIDOR TYPE CONDUITS

BETHLEHEM STEEL

Continued from page 228

thought to contain no moisture, had failed because of such moisture. Rubber insulation itself is moisture resistant so even if the sheathing or ducts fail to keep out the moisture, adequate protection is still provided.

RELAYING

Relaying was adequate, installed for each unit in addition to backup protection. Then if normal relaying failed, only a small section of the system would be cleared. The relaying is shown on page 97.

Each main transformer is protected by differential relaying; same for each bus or section of bus at three main stations 6A, 6B and 6F. Three main-station power lines, No. 20, 21 and 22, have pilot-wire relays. Bethlehem Steel has found that the only adequate way to protect individual lines in a closely knit system like this is by pilot-wire relaying.

Another interesting relaying feature is under-frequency relays on each synchronous motor. Because of reclosing scheme, the normal undervoltage relay would not clear synchronous motors from the system fast enough if all power failed. After under-frequency relays were installed a test was made under the worst conditions; all equipment clear of bus except the mg sets. Under-frequency relays were set at 58.5 cycles, and undervoltage relays at 70-v. Tripping time for under-frequency relays only was: No. 1 mg set—158 cycles, 6.3 sec; No. 2 mg set—153 cycles, 6.12 sec. By under voltage relay only, the time was: No. 1 mg set—1041.5 cycles, 41.7 sec; No. 2 mg set—1035.0 cycles, 41.4 sec.

Relaying of outdoor substation 6A is arranged so any internal fault in transformer banks, or between breakers on either side, trips both primary and secondary breakers and locks them out. But, faults that clear themselves often occur on the power-company lines. Power can then be restored almost at once. Hence provision is made to clear only transformer secondary breakers for a phase or ground fault on power-company lines.

When power is restored, a signal from potential devices in line-side bushings of primary oil-switches sets a reclosing device into operation. This closes the secondary breaker. Reclosing relays are set to reclose, 1st—15 sec; 2nd—30 sec; 3rd—75 sec, and then lock out.

Back-up relaying of power lines and bus sections is handled by a combination of overcurrent and directional ground relays, to clear sections if regular relays fail to function.

A supervisory control system came as

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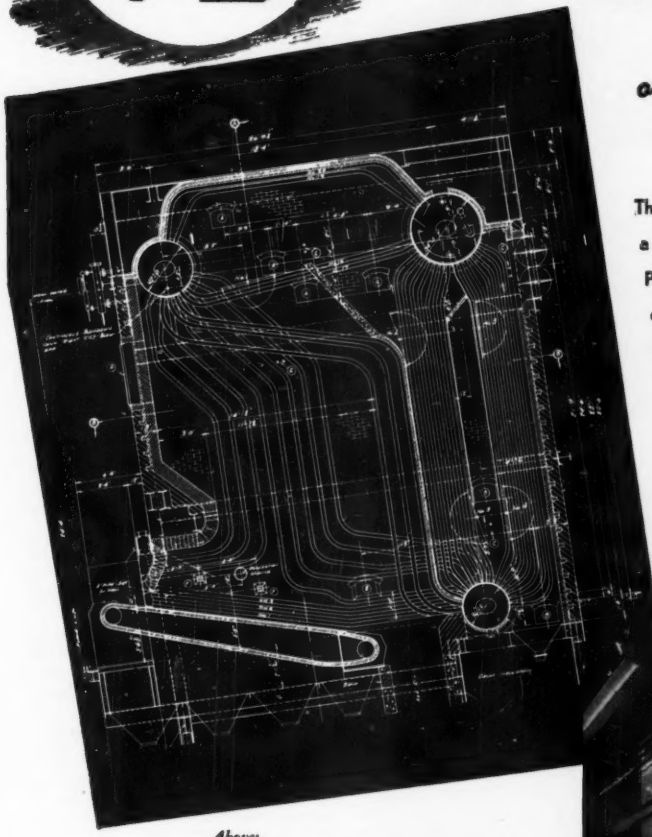
The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.



Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

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BETHLEHEM STEEL

Continued from page 230

an afterthought, mainly because of the remoteness of substation 6A. This system will give the operator in the hot-mill motor room, a method of controlling all line switches at stations 6A and 6B. Furthermore, it will tell him line and transformer loads, transformer temperatures, and positions of every breaker at either of these stations. With this system, he should be able to quickly and intelligently locate and clear up trouble.

ATOM POWER

Continued from page 102

If a pile of this general type were built for power generation, we would provide a much greater transfer of heat from the rods to a steam boiler. Amount of heat developed per ton of uranium is limited mainly by the rate at which we can remove the heat. That's why we would probably use a gas under pressure, perhaps helium, as a heat-transfer medium. We would also increase the temperature of the exit gas so as to make steam at a reasonable temperature and pressure for efficient power production.

With aluminum cans our surface temperature would probably be limited to 650 or 750 F, well below the steam temperature of good, modern power stations, but enough for a start. Some day we may can the uranium in zirconium or beryllium to withstand higher temperatures.

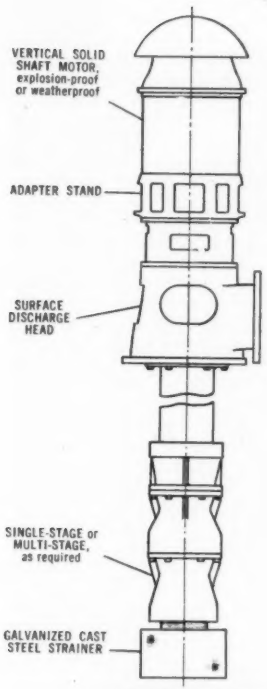
Heavy-Water Reactor. Main technical disadvantage of the graphite-moderated reactor is its great size, which makes it difficult to pressurize. A pile moderated by heavy water does the same job in much smaller space. An example is the Canadian reactor at Chalk River. There the reactive core is a tank of heavy water containing about 180 uranium metal rods.

A reactor of this kind might be developed as a power producer by pressurizing the tank and transferring the heat by circulating the heavy water through a steam generator or by transferring the heat directly from the fuel element to the boiler.

What About Cost? If it proves possible to "breed" fissionable material from uranium 238, what about the economics of a natural-uranium power producer? Uranium fuel may ultimately be much cheaper per kilowatt-hour than coal, oil or gas. Ample uranium supplies will be available.

On the other hand, it's clear that any atomic-power plant will cost much more to build. If the cost is about double that

NOTES FROM THE PUMP ENGINEER'S HANDBOOK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SINGLE-STAGE or MULTI-STAGE, as required
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The vertical turbine cooling tower pump has many advantages over other types. No suction valves or suction piping are required. With the pump bowls immersed in the tower sump, the operator is assured that the pumps are always primed; thus, are ideal for remote control or automatic operation. Vertical turbine pump horsepower requirements decrease as capacity increases, a characteristic which enables this type of pump to operate more efficiently at wider range of throttled capacity.

SHAFT WEAR CAN'T HAPPEN to a Johnston Water-Lubricated Pump!

Here's another QUALITY feature that makes Johnston Water-Lubricated Turbine Pumps a good investment. The renewable stainless steel sleeves which shroud the line-shaft at all points of bearing contact make it impossible for sand or other abrasives to damage the shaft. Sure, the sleeve and bearings wear on a Johnston just like they do on any pump . . . but think of the savings on parts and labor alone when you simply replace a sleeve instead of a complete section of shafting. What's more, you don't need a lot of special tools to do the job! Do it at the pump site . . . just unscrew the old sleeve and thread on the new!!!

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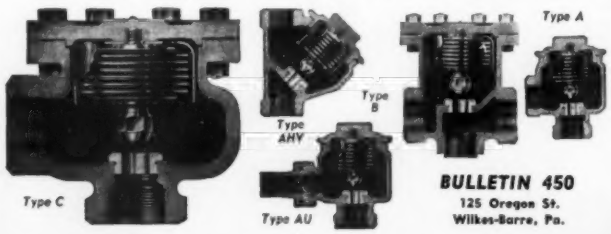
At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for Bulletin 450.



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TRAPS · VALVES · FLOATS

ATOM POWER

Continued from page 232

of a conventional coal-fired power plant, cost of power from such reactors will be only slightly more expensive than from ordinary power plants.

Generation of power from natural uranium reactors without breeding seems technically feasible. Their contribution to the United Kingdom's power needs would be worthwhile if supplies of uranium were adequate, but their waste of uranium makes them unattractive as a final answer to nuclear-power development.

The kind of reactor just described uses graphite or heavy water to slow down the neutrons. For effective breeding we should use a "fast" or "intermediate" reactor with little or no slowing-down medium.

One form of fast reactor might consist of a very compact core of almost pure uranium 235, surrounded by a blanket of thorium. As the U235 burned up in this reactor, it would generate another fuel, U233, from the thorium blanket. It is also possible, in a similar pile, to generate plutonium from U238.

Chief engineering problem of a fast reactor arises from the need to remove a lot of heat from a very small reacting core. That's why liquid metals, which have very good heat-transfer properties and low pressures at high temperature, will be used as heat-transfer fluids. But this forces us to develop the technology of liquid-metal coolants.

Also, we may have serious structural troubles from the intense bombardment inside the core of the reactor.

Our preliminary studies show that nuclear-power costs are likely to be about the same as the cost of power from coal. Right now, there's no point in splitting hairs and asking whether it will be a fraction of a penny less or more than coal; only experiments can settle that point. The important thing is to get going and build some power reactors.

[EDITOR'S NOTE: Heating of buildings at Harwell by atomic energy was described in the news article on p 148, Jan POWER. A heat exchanger, 10x10 ftx2½ ft, inserted in the pile's air-cooling system, picks up heat in water, which is circulated by a pump through a second heat exchanger. The latter supplies hot water, entirely free from radioactivity, for domestic use and heating of buildings. This domestic water, heated to 130 F, warms a space of 330,000 cu ft. Coal saving is said to be about a thousand tons a year, equivalent to $7420. Cost of the heat pickup installation is $42,000.

It should be stressed again that the Harwell reactor, which perhaps cost

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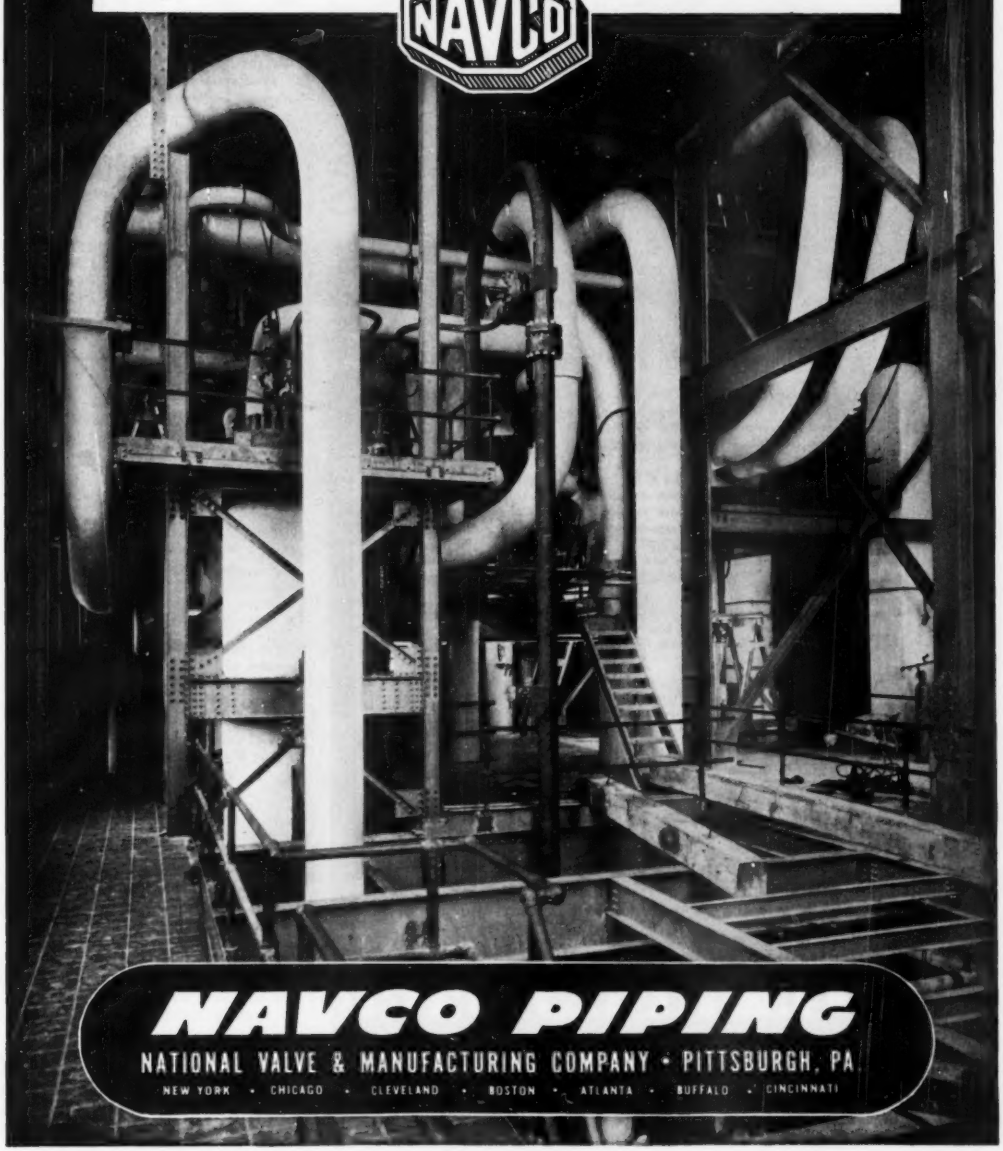

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FIVE FEATURES

for your Consideration:

1 . . . Compactness Note in the picture above the short axial length. Tubes 3" in size and larger are approximately 1 to 1½ diameters long, depending upon the velocity in the main. For high main line velocities (above 10 ft/sec. for liquids) tubes are less than 1 diameter in length.

2 . . . Ease of Installation Due to its compactness and because it requires no straight runs upstream or downstream, except near valves or regulators, the total space required for installation is but a small fraction of that necessary for other primary devices. It can be installed as readily as a fitting and in that section of the line most conducive to steady flow conditions. Moreover, it can be installed in the plant proper, eliminating the need for expensive vaults or housing.

3 . . . Reversibility The Foster Flow Tube is symmetrical transversely; upstream and downstream nozzles and ports are identical. This means that where processing calls for flow reversal, the meter can readily handle the changes.

4 . . . Low Head Loss Where head losses are important Foster Flow Tubes are designed with a main-to-throat ratio that provides negligible unrecovered head losses.

5 . . . Accuracy All Foster Flow Tubes are furnished with calibration curves obtained in laboratory tests simulating installation conditions and can therefore be guaranteed to an accuracy to meet any specification.

Foster Flow Tubes are recommended for a wide range of services metering the flow of liquids and wet or dry gases. They are available in all commercial pipe sizes with flanged or screwed connections. Standard lining is bronze but other materials are available. In writing for further information, give processing and installation details of your metering requirements.

FOSTER ENGINEERING

ATOM POWER

Continued from page 234

about $25 million, was never designed to generate useful heat. The building heat is merely an incidental pickup from a research installation.

If it were thought important, a similar arrangement could be installed at the Brookhaven, Long Island, N. Y. reactor. There, as at Harwell, the reactor is cooled by a blast of air, which is then discharged to waste through a high stack. It would be possible at Brookhaven, exactly as at Harwell, to place a heat exchanger in the duct and use the heat for warming buildings.

Photos on page 102 show the primary Harwell exchanger installed in radio-active air duct.]

WITH OUR READERS

Continued from page 5

MORE ORCHIDS:

With no particular reference made to your article, we have passed December issue of POWER around to various members in our plant. Invariably they have referred to your article with complimentary remarks as to the simplicity and clearness of the presentation of the subject.

Tallassee, Ala. J H BODDIE
Mt. Vernon Woodbury Mills, Inc

. . . you are certainly to be congratulated on a most practical, well-organized and easily understood presentation of a subject so vast and technical in scope.

St. Louis, Mo. A R KLOOS
Lincoln Engineering Co

This is without a doubt the best all-around treatise on the subject that it has been our privilege to see for a period of many years.

Bristol, Conn. CARLETON BECKWITH
New Departure Div, General Motors Corp

I've just finished reading through the booklet and sincerely feel it is a fine piece of work and contains a tremendous amount of valuable information. I certainly compliment you and your staff on the preparation of this comprehensive study. . . .

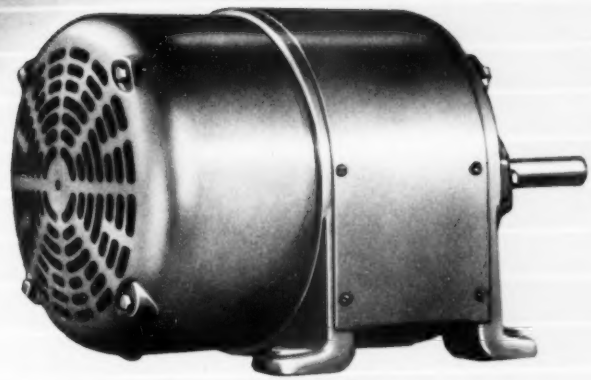
Fort Worth, Texas J C HARGIS
Panther Oil & Grease Mfg Co

American Society for Engineering Education is issuing a call to industry, the professional societies, public or private research organizations, and the engineering colleges for teaching aids which may be reviewed in its forthcoming Catalog of Teaching Aids. This publication, prepared by the Society through its Committee on Teaching Aids, will review all kinds of aids for teaching various engineering subjects.

Dr Charles F Wagner, **Westinghouse Electric Corp,** consulting engineer, has been awarded the 1951 Edison Medal for distinguished contributions in power system engineering by an AIEE committee.

CERTIFIED

SAFE



TOTALLY-ENCLOSED

AND EXPLOSION-PROOF

U.S. MOTORS

100% Safe... U. S. TOTALLY-ENCLOSED MOTORS

Without equal for dependability, this advanced line of motors insures safest power and longest life. The vital elements are given utmost protection against external hazards. The explosion-proof types are certified safe by Underwriters' Laboratories, Inc.

NORMALIZED CASTINGS

All castings normalized to remove internal stresses and maintain original accuracy of bearing settings and air-gap between rotor and stator, insuring far longer bearing life.

HI-DRAFT VENTILATION

Ventilating fan is of non-sparking material for explosion-proof motors. Designed with split hub, permitting quick removal. Tight in operation. Multi-bladed for quietness.

LUBRIFLUSH BEARINGS

Self-lubricated for normal life—and with the extra advantage of Lubriflush, permitting relubrication when desired without disturbing the bearings. Fresh lubricant is injected; old grease is purged.

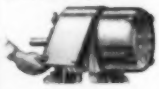
ASBESTOS-PROTECTED WINDINGS

Asbestos-protected windings withstand high temperatures and guard against carbonization. Each wire is insulated and isolated with asbestos, to protect against burn-outs & increase motor life.

SPLIT HUB FAN

The propulsion fan forces an air blast against lamination edges, dissipating the heat as fast as it generates—keeping the motor continuously cool. The air is drawn in through end grill.

REMOVABLE COVER



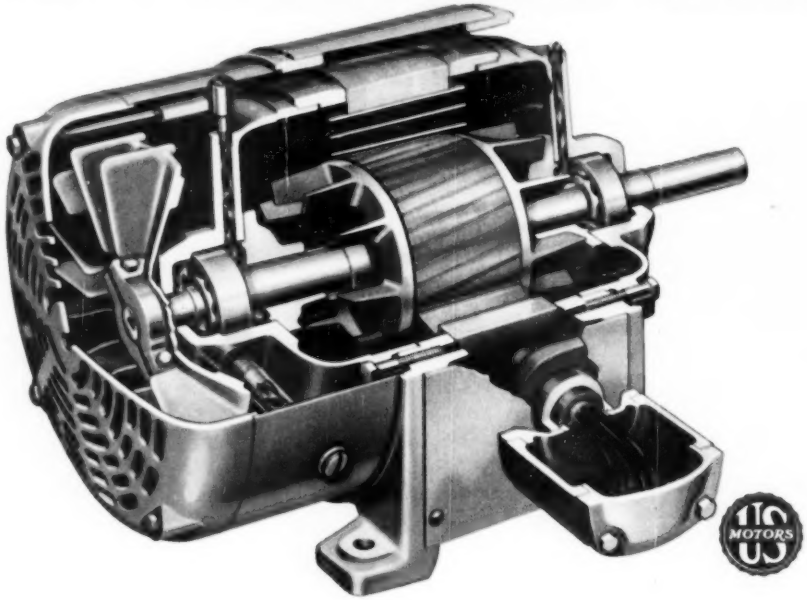
The cover plate can be quickly removed by loosening screws for inspection and to eliminate deposits of dust, dirt, lint, oil and all other accumulations.

CENTRICAST ROTOR

Centrifugally cast from molten aluminum into a solid, indestructible structure, free of defects.

SEALED TERMINAL

Extra large chamber is sealed with special compound, very high in dielectric strength and with a high melting point.



SMOOTH GRILLE

For protection of the fan and to prevent entrance of debris, an end grille is provided; smoothly contoured.

CERTIFIED SAFE FOR HAZARDOUS SERVICES

U. S. Totally-Enclosed Motors carry the official Underwriters' label for explosion-proof services in Class I, Group D, for highly inflammable gases and volatile liquids, and Class II, Groups F and G for combustible dusts. These motors are also available for non-explosion-proof services such as chemicals, dust and moisture, without label, and with or without fan —Horizontal, Vertical and Varidrive types. New Bulletin gives full details.

U. S. Electrical Motors Inc.
Box 2058, Los Angeles 54, Calif.
or Milford, Conn.

Send your new Bulletin illustrating and describing U. S. Totally-Enclosed Motors. ☐ Also General Bulletin of all U. S. Motors. ☐

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

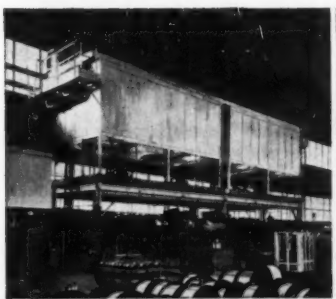
U.S. ELECTRICAL MOTORS Inc.

PACIFIC PLANT: Los Angeles 54, Calif. (P.O. Box 2058) **ATLANTIC PLANT:** Milford, Conn.

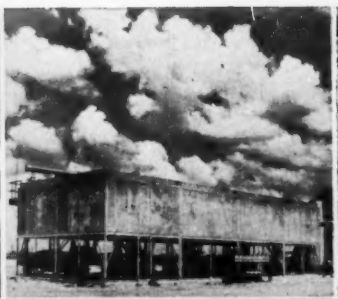
Atlanta 3, Ga. · Bakersfield, Calif. · Boston 16, Mass. · Chicago 8, Ill. · Cincinnati 16, Ohio · Cleveland 14, Ohio · Dallas 9, Texas · Detroit 2, Mich. · Fresno 1, Calif. · Houston 4, Texas · Indianapolis 4, Ind. · Milwaukee 1, Wisc. · Minneapolis 2, Minn. · New York City 6, N. Y. · Philadelphia 2, Pa. · Pittsburgh 2, Pa. · San Francisco 7, Calif. · Seattle 1, Wash.
Sales and Service offices in all principal cities.

You can put FIN-FAN the air-cooled exchanger

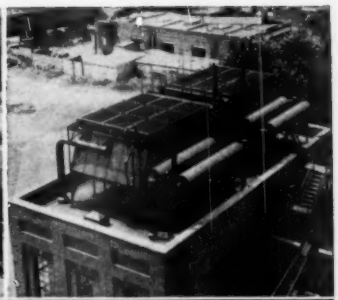
INDOORS...OUTDOORS...ANYWHERE



IN A BUILDING



ON THE GROUND



ON A ROOF

YOU CAN PLACE the *air-cooled* FIN-FAN Exchanger at any convenient location. It is compact, self-contained and requires neither cooling-water piping nor natural draft.

WITHIN A BUILDING—You can install a FIN-FAN on or above the floor. In one large industrial plant, the FIN-FAN unit was elevated to leave the floor free for a tool room.

ON THE GROUND—When indoor space is limited, you can place a FIN-FAN Exchanger outdoors without affecting its efficiency in any way. Because it uses forced draft, the unit develops its own positive air circulation, which is independent of the surrounding air or the direction and velocity of prevailing winds.

ON A ROOF—Many FIN-FAN Exchangers are installed on roofs without overloading the structures. The weight of these units is evenly distributed over their entire area.

This installation adaptability is only one of the many important advantages of FIN-FAN Exchangers, developed jointly by Fluor Corporation Ltd. and The Griscom-Russell Co. The panel at right mentions additional distinctive features. For complete information, write for Bulletin 1231.

FIN-FAN "EXTRAS"

WIDE RANGE OF SERVICES—It is suitable for cooling liquids and gases and for condensing vapors at pressures up to 5,000 psi. and temperatures up to 1500F.

ELIMINATES COOLING WATER PROBLEMS—You avoid all the complications and expenses of a water supply system . . . no water piping, pumps, treatment, disposal or make-up; no corrosion, scaling, freeze-ups, or structural repainting due to the use of water.

SERVES TWO OR MORE FUNCTIONS—You can use a single installation for two or more cooling and condensing duties simultaneously.

THE GRISCOM-RUSSELL CO. • MASSILLON, OHIO

GR-258

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

Remove Oil...

FROM BOILER AND PROCESS WATERS THIS NEW LOW-COST WAY!

What it is —

Filtration with Sorbo-Cel is a simple, low-cost method of removing emulsified oil from water. In plants using steam generating equipment, it is proving an especially effective and economical means of obtaining oil-free condensate for boiler feed. It also provides a practical solution to other oil-contaminated water problems, such as the water used in pumps, condensers, cooling systems, moving driers, etc.

How it works —

The method is similar to that used in other conventional industrial filtration operations. A small amount of Sorbo-Cel (a specially processed diatomaceous silica powder), is added to the water to be filtered. This is then pumped through a pressure filter where the oil globules are adsorbed by the specially treated Sorbo-Cel particles. Both are retained on the filter screen, the filtered water alone passing through. Any type of pressure filter having a metal screen and capable of operation at a pressure differential of 30 psi or more may be used.

What its advantages are —

Sorbo-Cel filtration is fast, economical and efficient. It assures virtually complete removal of oil, as well as suspended solids such as rust, scale, clay, etc. Large volumes of water are filtered in a relatively short time, yet total costs (including both material and operation) range from only 1¢ to 3¢ per 1000 gallons of water filtered.

For further information about Sorbo-Cel filtration use the coupon below.

JM

Johns-Manville
SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.

Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

Pow-2

MORE APPOINTMENTS

Begins on page 210

Tex. (factory branch office) George H Woodard, mgr; 1002 Second Ave, Seattle 4, Wash. (factory branch office) Henry Weber, dist mgr; 13 S Meramec St, Clayton 5, Mo. (dist office) Wm G Baker in charge; 308 Suburban Square Bldg, Ardmore, Pa. (dist office) Louis C Walter, dist mgr; 317 State Tower Bldg, Syracuse, N. Y. (branch office) Wm J Angus, dist engineer; Charles T Duffy is now in charge of the Buffalo branch office.

Purolator Products, Inc appoints Joseph G Van Nest director of purchases, and Donald C Huber asst advertising mgr.

Perfex Corp appoints Harold H Hatch service mgr for the controls div; Idwal W Parri becomes dist mgr in Portland, Ore. R B Dunning, Bangor, Me., are northwestern Maine distributors.

Delta-Star Electric Co, div of H K Porter Co, Inc, appoints J C Hydrick works mgr.

Rockwell Mfg Co reorganizes its sales dept. New regional managers are M J Harper, New York City; P C Kreuch, Pittsburgh; J W Northcutt, Atlanta, Ga; C K Madison, Houston, Tex.; H Boezinger, Los Angeles, Calif.

Black, Sivalls & Bryson, Inc, places L M Petrie in charge of new office at Box 655, Wichita Falls, Tex.

Borg-Warner Corp, Ingersoll products div, appoints A J Robertson mgr of defense sales, and L R Miller mgr of contract sales.

Air Reduction Co, Inc, elects J H Humberstone vice-president. New president of the Airco equipment mfg div is Scott D Baumer.

Air Conversion Research Corp has new address—4107 N Damen Ave, Chicago 18.

Harbison-Walker Refractories Co transfers H G Hart to the new specialties and retail dept in Pittsburgh; Floyd A Pearce moves to the Portsmouth, Ohio sales dist; E A Olson is appointed to the Pittsburgh sales dist. J C Willey becomes asst to the president.

Hills-McCanna Co appoints E Frank Miller mgr of its eastern div with offices in New York City.

Certified Flexible Couplings appoints Bernard Havens sales representative in the Chicago area.

Chicago Metal Hose Corp changes its name to Flexonics Corp, in order to have a name more representative of the scope of company activities.

Sterling Electric Motors, Inc begins production in new plant in Van Wert, Ohio. Executives at the new plant are E O Danielson, gen factory mgr; B L Peak, supt. E K Johnston becomes gen supt of the Los Angeles plant.

Taylor Instrument Co's have new gen sales mgr—Frank S Ward; industrial sales mgr—Albert J Fleig. George E Heller becomes mgr of industrial sales to the chemi-

1,000 PACKING PROBLEMS with 1 Solution . . .

BELMONT
SHEET PACKINGS

Yes, regardless of the problem—whether it's temperatures encountered; pressures to be sealed; unique resiliency requirements to be met; abrasive resistance to be overcome or tensile strength and toughness specifications to be lived up to—as long as you have flange and parallel surface joints to connect, you'll always find the most satisfactory sealing answer in Belmont Sheet Packings.

Standard Belmont Sheet Packings are obtainable in sheets or rolls (according to style). The constructions include—compressed asbestos, asbestos metallic, red rubber, cloth inserted, vegetable fibre and a wide range of other basic materials and combinations, all scientifically formulated to provide BETTER SEALING . . . LONGER LIFE.

For permanent joints or joints that must be taken apart frequently . . . for pliability . . . for compressibility . . . for the packings that will not creep or blow, try Belmont—the sheet packings made for every conceivable type of service. Distributors in every large industrial center are at your service.

For engineering or technical help on special jobs, write direct.

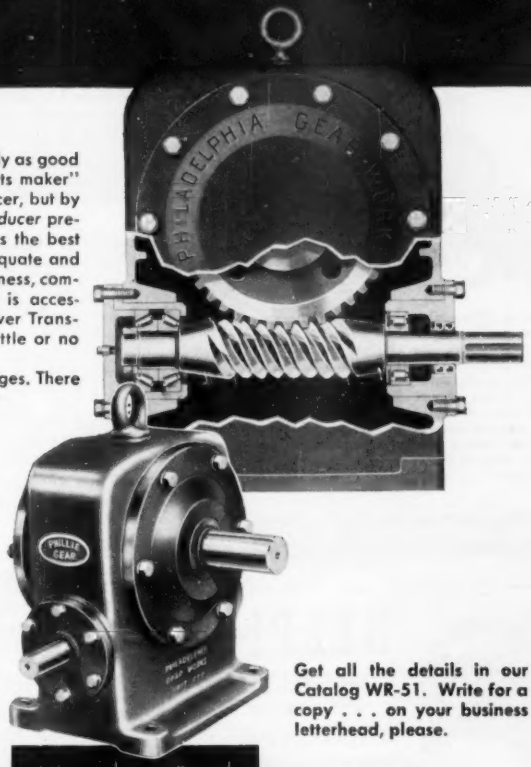
Catalog #40 is available, write for it.

CUT YOUR OWN GASKETS
WITH BELMONT GASKET CUTTER
BELMONT GASKET CUTTER
A portable tool for cutting 1¼" dia. to 19" dia. circular gaskets from all kinds of soft sheet packings. Rigid and simple to operate. Larger sizes only require cutter bar replacement.
THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pa.
BELMONT
There's a Belmont Packing for every service
Rings · Spirals · Coils · Reels · Spools · Sheets · Gaskets
Steam · Water · Oil · Gas · Air · Acids · Alkalies · Ammonia

There's *far more* to a SPEED REDUCER than GEARS

It has frequently been said that: "any Reducer is only as good as the *experience and manufacturing facilities* of its maker" . . . *Gears are vitally important* in any Speed Reducer, but by themselves, they are *just Gears. A good Speed Reducer* presupposes also that it is properly engineered; it has the best anti-friction Bearings; the lubrication system is adequate and highly efficient; the Housing is designed for ruggedness, compactness and proper heat dissipation. The Unit is accessible—and it will deliver a high efficiency of Power Transmission over a long period of service life, with little or no attention.

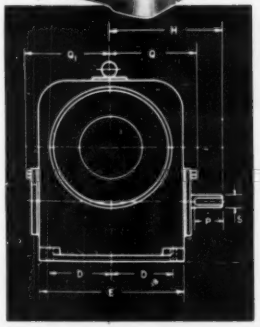
Philadelphia Reducers offer all of these advantages. There is a type and size of Philadelphia Worm Reducer for every industrial requirement.



FEATURES . . .

OF THE TYPE A-T-O AND R-T-O PHILADELPHIA WORM GEAR SPEED REDUCERS

- Units are available with Worm "above" or "below" the Worm Gear, or in Vertical Units.
- Worms are made of alloy steel with carburized, hardened and tempered threads—both shaft and threads are accurately and smoothly ground after heat-treatment.
- Worm Gears are of highest quality chill cast nickel-bronze.
- Bearings are anti-friction types (ball or roller) best suited for smooth, quiet, trouble-free operation (see cut-away illustration).
- Housings are quality grey iron—compact, neat, rigid and of ample radiating surface to prevent overheating.
- All units carry A.G.M.A. rating.
- Easy accessibility for removal of either Worm or Worm Wheel assemblies, from the housing.
- Lubrication by splash system to all moving parts, in oil-tight housing.
- Efficiencies as high as 96%.



Get all the details in our Catalog WR-51. Write for a copy . . . on your business letterhead, please.

Philadelphia Gear Works, INC.

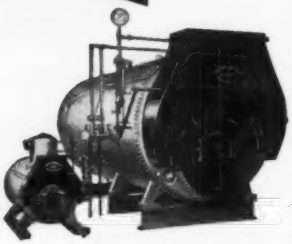
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

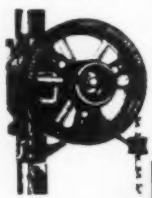
A BOILER With Economy
A LEFFEL Scotch Boiler!



Users of self-contained, compact Leffel boilers report fuel savings of from 20 to 40 percent over other types. The 17 sizes are available in ratings of from 6 to 250 *actual* horsepower. And the sturdy, dependable construction of all Leffel boilers permits substantial overloading with safety. Designed to burn COAL, GAS, or OIL, they are easily converted from one fuel to another. There is an efficient Leffel Scotch type boiler, easy to install, ready to go to work in your plant . . . today!

Write for descriptive catalog

The James Leffel & Co.
established 1862
DEPT. O SPRINGFIELD, OHIO



HELP!
FOR EVERYONE
WHO HANDLES
VALVES OR PIPING

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

● Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Control overhead valves with ease and certainty, no matter how high up—right from the floor! No more climbing on bench, machine, boiler, treacherous stepladder. For overhead pipe layouts, plan on putting valves wherever needed. The BABBITT adjustable Sprocket Rim with Chain Guide is especially designed for easy, positive control of those out-of-reach valves—from the floor.

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

MORE APPOINTMENTS

Begins on page 210

cal industry; Richard N Pond is div sales mgr handling sales to the petroleum and canning industries.

Timken Roller Bearing Co appoints R G Wingerter asst gen mgr and J R Splitstone dist mgr of its automotive sales div.

Watson-Stillman Co appoints Adolph J DeMatteo chief engineer. Jackson Kemper is new gen mgr of sales, distributor products div.

Walworth Co elects W B Holton Jr chairman of the board, and Alfred J Eichler president.

National Electric Products Corp closes its Philadelphia warehouse and transfers those operations to new plant in Linden, N. J. Philadelphia sales office moves to Suite 404-5-6 Architects Bldg, 17th and Sansom Sts. Lloyd Clark is dist mgr.

Whitney Chain Co appoints J Henry Anthony mgr of the industrial engineering division.

New York Belting and Packing Co appoints Donald C Howard factory representative in Calif., Nev., and southern Ore.

Hewitt-Robins Inc moves its Philadelphia office to Coral and Hagert Sts, Philadelphia 25.

Ampco Metal, Inc appoints Nelson S Cobleigh dist mgr of the Philadelphia sales div.

Quigley Co Inc appoints Bud Reagan sales representative in Mo., Kan., Neb., Iowa, N. and S. Dak., Minn., Wis., and Chicago; Leroy Montgomery is representative in W. Va., western Pa., Ohio; Ira Stark is representative in N. Y and New England; Jack Pittman is representative in Tex., La., Ala., southern Miss. and Ark.

International Rectifier Corp opens new factory at 1521 E Grand Ave, El Segundo, Calif.

Caterpillar Tractor Co has new wholly owned subsidiary—Trackson Co of Milwaukee.

W B Connor Engineering Corp elects John H Bartol a vice-president.

Pacific Electric Mfg Corp appoints R W Hutchinson as eastern div mgr at the Gary, Ind., plant.

Rust Engineering Co names A H Krause asst chief engineer, and John F Hurley mgr, boiler brickwork div.

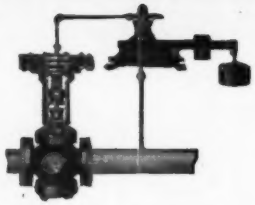
Central Maine Power Co appoints Ford W Harris chief engineer.

OBITUARIES

James A Rafferty, 65, vice-president and director of Union Carbide and Carbon Corp died Dec. 19 at Fort Lauderdale, Fla.

Charles G Thornburgh, 62, vice-president of the Rust Engineering Co. died suddenly Dec. 5 at his home near Carnegie, Pa.

ATLAS
Super-Sensitive
PRESSURE REGULATORS



How to Order:

Always give the size of control valve, initial pressure, controlled pressure, and the available water pressure for operating the regulator. For various reduced pressures and sizes of control valves, specify as follows:

ATLAS 801 • For reduced pressures of 2 to 15 lb., Globe screwed, ½" to 2"; Globe flanged, 2½" to 6".

ATLAS 801-B • For reduced pressures of 0 to 5 lb., Globe screwed, ½" to 2"; Globe flanged, 2" to 6".

ATLAS 802 • For reduced pressures of 15 to 150 lb., Globe screwed, ½" to 2"; Globe flanged, ½" to 6".

ATLAS Super-Sensitive Pressure Regulators are particularly adapted to service where pressures must be maintained within fractions of one pound and without perceptible variation even where demands fluctuate and widely varying initial pressures occur. They are suitable for steam, air or gas where it is essential to maintain a constant reduced pressure in heating mains, vats, cookers, retorts, etc. They are also used as altitude regulators to maintain constant level in open tanks, or as a pump governor to assure constant pump discharge pressure.

• • •

BULLETIN 1-B gives complete information on the above as well as the ATLAS Compound Super-Sensitive Pressure Regulator. Use the coupon below and at the same time check the other ATLAS products on which you want complete data.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
289 South Street, Newark 5, N. J.
Represented in Principal Cities

ATLAS VALVE CO., 289 South St., Newark 5, N. J.
☐ Please send bulletin, No. 1-B on ATLAS Super-Sensitive Pressure Regulators. Also, please send complete data on the following ATLAS Products.

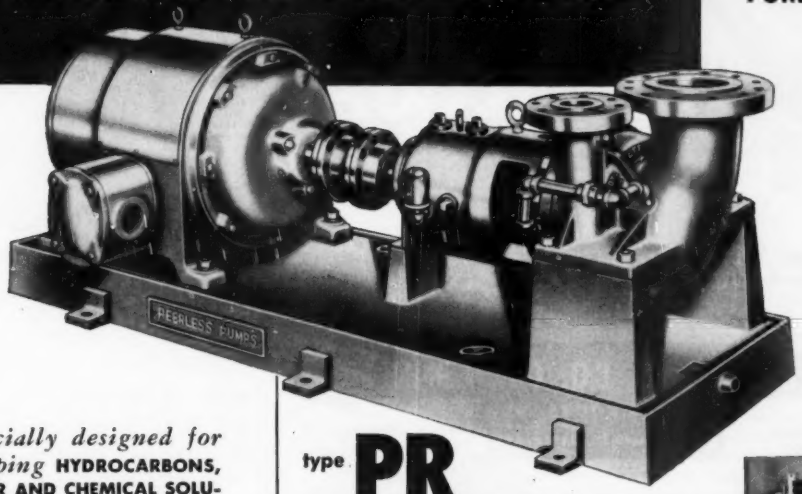
☐ CAMPBELL Boiler Feed Regulators
☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control System
☐ Pressure Regulators
☐ Pump Governors
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves
☐ Oil Control Cocks

Name .....
Firm .....
Street .....
City ..... State .....

PEERLESS TYPE PR

A CENTER-LINE-MOUNT PUMP FOR HEAVY DUTY PROCESS SERVICE IN REFINERIES AND CHEMICAL PLANTS

Peerless BUILDS **DEPENDABLE PUMPS**



Especially designed for pumping **HYDROCARBONS, WATER AND CHEMICAL SOLUTIONS AT ELEVATED TEMPERATURES AND PRESSURES...**

CHARACTERISTICS AT A GLANCE

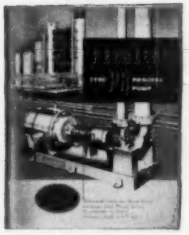
CAPACITIES	Up to 1000 gpm
OPERATING HEADS	Up to 625 feet
TEMPERATURES	Up to 850° F.
CASE PRESSURES	Up to 600 psi
DRIVES	Horizontal electric motor is standard; others as required, such as steam turbine drive or stationary engine drive.
MATERIALS OF CONSTRUCTION	Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required for the intended service.
LIQUIDS HANDLED	Hot oil, propane, butane and all petroleum hydrocarbons, process liquids and water.
NPSH CHARACTERISTICS	Designed to operate with minimum available NPSH.

type **PR**

FOR THOSE TOUGH HIGH-TEMPERATURE AND HIGH-PRESSURE APPLICATIONS IN REFINERY AND PROCESS WORK . . .

Maximum interchangeability, extra-heavy wall thicknesses, extra-low NPSH requirements and extra-rigid case-frame construction make the Peerless Type PR pump ideal for those rugged duty jobs in a large number of industrial services.

Furnished in a complete range of sizes, a Peerless Type PR will cover nearly all your pump needs. Available in various alloy materials. Adequate water-cooling jackets and water-cooled stuffing box, with mechanical seal optional, and heavy duty shaft with carefully balanced bearing design are features of the Peerless Type PR construction. Many sizes are available from stock in standard materials.



New Bulletin just off the press

Use coupon for Bulletin No. B-1605 which describes the exacting design and construction features of Peerless Type PR pumps.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N. M., Tulsa

fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE _____

POW

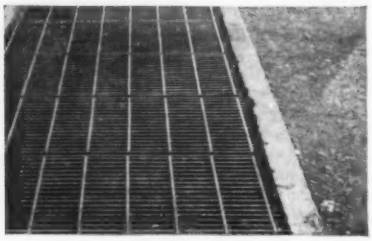
Tube Stocks and Bending

BOILER TUBE CO. OF AMERICA
McKEES ROCKS, PA.
(Pittsburgh District)

PITTSBURGH
CHICAGO

FRED S. RENAULD & CO.,
LOS ANGELES

Hendrick Heavy-duty Grating...



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withstands weight of heaviest trucking, inside or outside of industrial plants . . . excellent for drainage applications . . . for coal grizzlies . . . and wherever it is necessary to sustain unusually heavy loading.

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Begins on page 167

Tick? gives basic product information on Towmotor construction features, handling methods. Based on 15-min. sound-slide film. Booklet distributed after showing of film. ★ Request direct, not from POWER. Towmotor Corp, Cleveland 10, Ohio.

B35 **ELECTRIC TRUCKS**—12-page bulletin P5151 describes complete line of electric trucks in capacities from 1000 to 100,000 lbs. Types, features, application, selection. Yale & Towne Mfg Co, 11,000 Roosevelt Blvd, Philadelphia 15, Pa.

METALS AND ALLOYS

B36 **METAL AND ALLOY IDENTIFICATION**—Rapid spot-testing method for identifying common materials. 48-page booklet gives qualitative test procedures, directions for preparing reagents, chemical compositions of common metals and alloys. International Nickel Co, Inc, Development and Research Div, New York 5, N.Y.

B37 **NICKEL ALLOY STEEL CASTINGS** — Applications, typical compositions and properties, advantages, recommended specifications. 32-page bulletin. International Nickel Co, Inc, Dept EZ, New York 5, N.Y.

B38 **BRAZE-CLAD METALS**—Metal strip clad with silver brazing alloy. Simplifies silver brazing. 4-page bulletin BC-51 gives applications, explains how braze-clad metals work. American Silver Co, Inc, 36-07 Prince St, Flushing 54, N.Y.

B39 **LEAD-CALCIUM FOR STORAGE BATTERIES**—4-page reprint of article gives laboratory test data, reports on experiments leading to development of lead-calcium for battery-plate grids. Gould-National Batteries, Inc, Trenton 7, N.J.

METERS AND INSTRUMENTS

B40 **VOLT-AMMETER** — *Amprobe* snap-around type for service work. 16-page booklet No. 504 gives specifications, dimensions, case histories. Pyramid Instrument Corp, 49 Howard St, New York 13, N.Y.

B41 **MINIATURE RECORDER** — Strip-chart type, designed for graphic panel use. No back-of-panel adjustments. 6-page specification sheet 769 gives photos, dimensions, specifications, operation. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

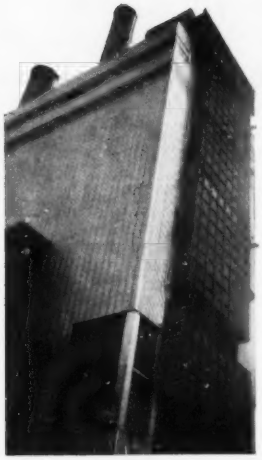
B42 **RECORDING POTENTIOMETER**—4-page instrumentation data sheet No. 10.14-6 describes operation of a gas dust analyzer with *Electronik* potentiometer. Sampling layout, operation of instrument, application. Minneapolis Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B43 **FILTER GAGES**—Mechanically operated. Measure rate of flow, loss of head, water level. 4-page bulletin 450-H10 gives description, principles of operation, specifications. Builders-Providence, Inc, 345 Harris Ave, Providence 1, R.I.

B44 **LOW-PRESSURE CELLS**—0-10 to 0-100 psi capacity for measuring variations in gas or liquid pressures. 2-page bulletin 326 has photos, wiring diagram, dimensions, specifications. Baldwin-Lima-Hamilton Corp, Philadelphia 42, Pa.

B45 **NON-FROSTING GAGES** — Standard and large chamber, reflex and transparent types. 2-page bulletin, unit 177, has photos, descriptions. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

B46 **CO_2 RECORDER**—*Condu-Therm* unit works on thermal conductivity principle; electronic type operation. 12-page bulletin 51-1008 gives de-



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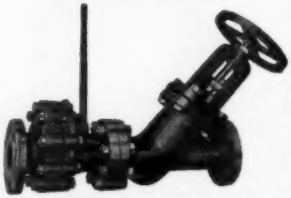

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

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scription, operation, applications. Hays Corp, Michigan City, Indiana.

★ **LOAD CELLS**—Change mechanical force into linear electrical signal to be fed to recorders and indicators. Torsion bar and cantilever beam types. Ranges 0-100, 0-2500 lbs. Two 4-page folders No. 62 and 65. ★ Write direct on company letterhead to Automatic Temperature Control Co, Inc, 5200 Pulaski Ave, Philadelphia 44, Pa.

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B48 **SPRAY NOZZLES** — Non-clogging type for cleaning purposes. 4-page folder 2386 gives dimensions, capacities, uses. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

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B51 **VAPOR PURIFIERS**—Internal downflow type. Guaranteed to deliver vapor with 1.0 ppm or less of total solids. 2-page bulletin No. 400 gives description, dimensions. V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio.

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B53 **TURBINE-GENERATOR UNITS** —NEMA ratings 2000 to 7500 kw. Condensing type for power generation only; non-condensing and automatic extraction types for process steam and a steam-power balance. 8-page bulletin 03B7654 has diagrams construction. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B54 **TURBO - GENERATORS** — Brush-Ljungstrom units. 24-page publication No. 61003 gives details of design and construction features. Photos, cross-section diagrams, theory of operation, overall dimensions. Brush Electrical Engineering Co, Ltd, Loughborough, England.

B55 **DIESEL USES**—Uses of diesel engines in our modern economy. Booklet written in rhyme. Detroit Diesel Engine Div, General Motors Corp, Detroit 28, Mich.

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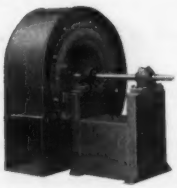

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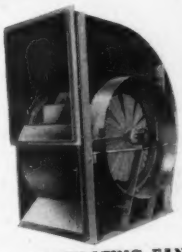

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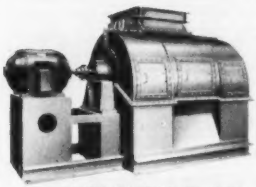

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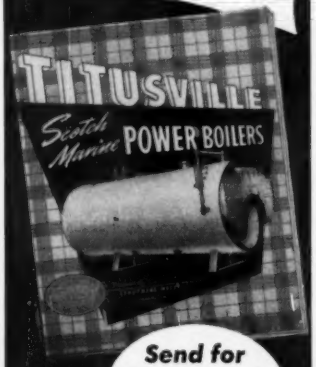

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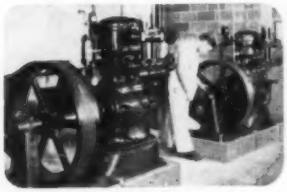

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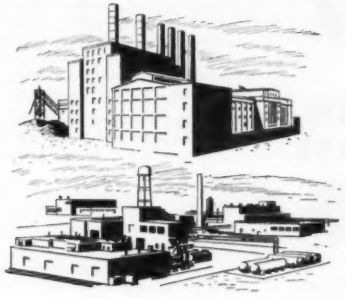

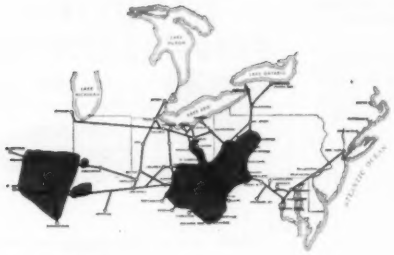

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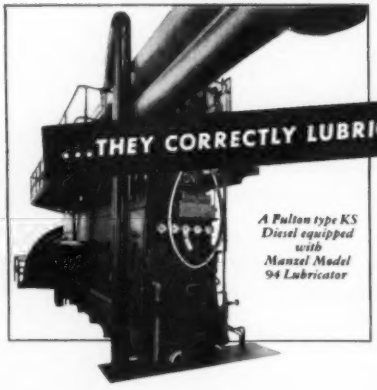

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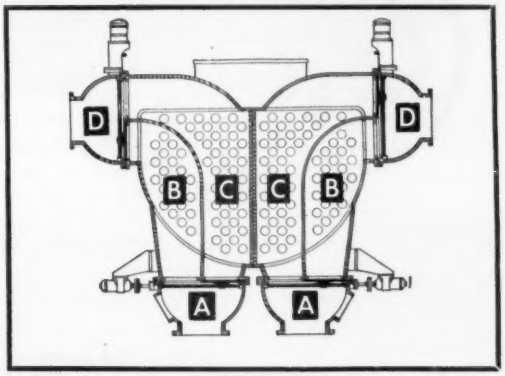


CROSS-SECTION DUAL BANK CONDENSER SHOWING HOW "REVERSE FLOW" WORKS

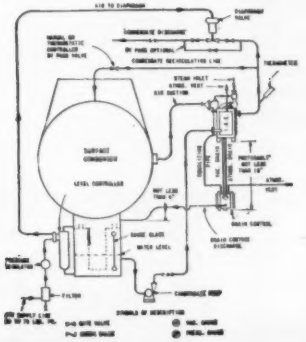
Both halves work the same but independently of each other.

Right Side: Water enters divided water box at valve chamber D, with lower port open. It flows through pass B to end of condenser, back through pass C and out through left port of A.

Left Side: Flow is reversed: Valves at inlet D and discharge A are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of A.

RECOMMENDED HOTWELL LEVEL CONTROL WITH TUBEJET AIR EJECTOR

This diagram is typical of the information awaiting you in Specification 88. This 4-page illustrated bulletin describes the improved steel shell Tubejet Air Ejectors with combined surface type inter-after condenser. Many power plant engineers are adopting this more reliable, space saving equipment for stationary power plant use. A request on your company letterhead will bring a copy of Specification 88 by return mail.



C. H. WHEELER COOLING TOWERS for MUNICIPAL POWER PROGRAM

Following construction of two 7-cell, 30,000 GPM cooling towers at the Leon Creek Power Station of San Antonio, Texas, C. H. Wheeler was awarded the construction of a third and larger tower. The new tower will handle 55,000 GPM to serve a 60,000 KW generator. It is a 13-cell induced-draft tower designed for 76.5° wet bulb, taking water at 105.5° inlet and cooling it to 90° outlet. Proposed construction is 39'8" x364'x29'. It will resist 30 lbs. per square inch wind pressure, or 100 mph hurricane force. Gibbs & Hill, New York, are the engineers and constructors on the job.

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STOP UNEXPECTED boiler tube failures

THE TURNER BOILER TUBE SCALE THICKNESS INDICATOR eliminates guess work in boiler maintenance. Locates defective tubes prior to their failure. Check the "hot spots". Check on the effectiveness of your water treatment. Check on your tube cleaning methods. *Write to*

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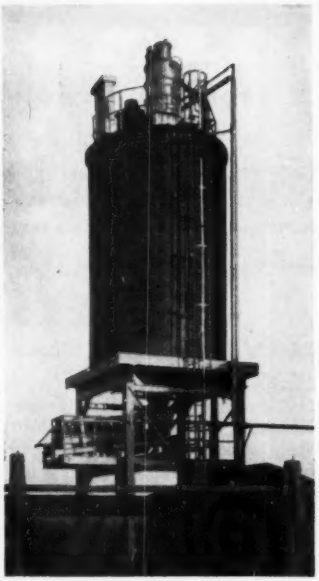

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A survey of your plant by a NATIONAL engineer may reveal that ash removal costs are cutting your profit margin. A survey will cost you nothing . . . may very well boost your earnings.

NATIONAL PNEUMATIC STEAM ASH REMOVAL SYSTEMS
add to the efficiency of your plant in two ways —

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INSTANTANEOUS WATER HEATERS

Proved by PERFORMANCE in
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PICK heaters provide hot water INSTANTLY by steam injection. They're entirely automatic to provide and accurately maintain pre-set temperatures. Exclusive Pressurizer Piston eliminates pipe hammering and shaking. Available in sizes and combinations to provide any volume needed. Installation is simple — requires only ordinary pipe connections.

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No Storage Tanks Needed
Compact design permits installation in corners, on walls, or overhead.

Easily Cleaned
No coils. Can be cleaned in a matter of minutes — without dismantling.

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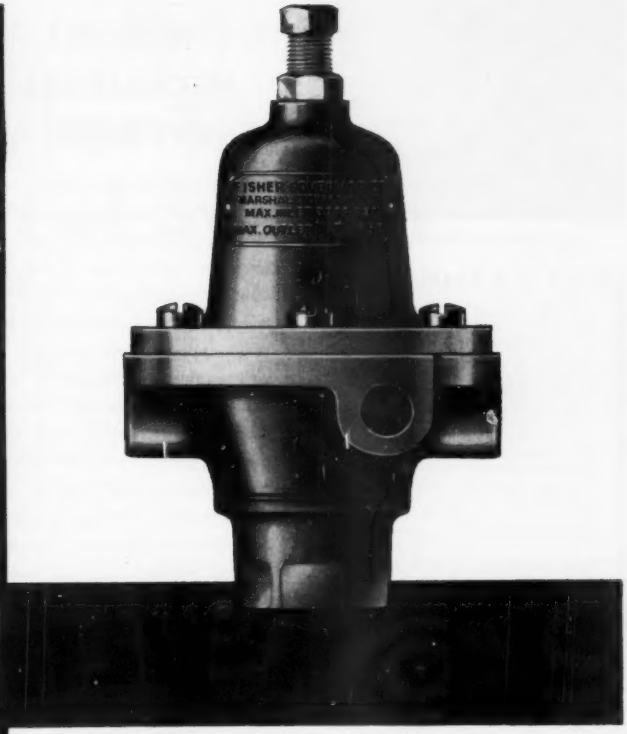
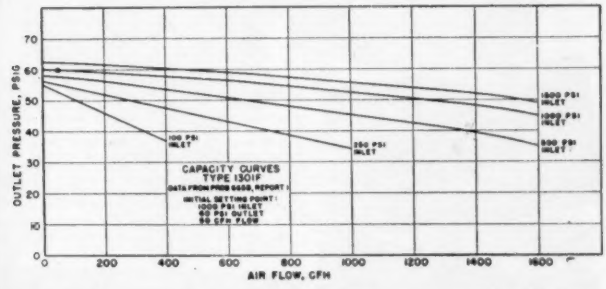
HIGH PRESSURE REDUCING VALVE for AIR or GAS SERVICE



Type 1301F is commonly used in conjunction with pilot operated controllers where high pressure operating medium is used. They are also used in general industrial applications for high pressure reduction of non-corrosive air or gas.

CONSTRUCTION:
All forged bronze construction with glass impregnated Teflon valve disc, stainless steel orifice. Furnished with one inlet connection and two outlet connections of ¼" pipe size.

PRESSURE RANGE:
Suitable for inlet pressures up to 3000 PSI; reduced pressure spring ranges of 10 to 75 PSI; 50 to 150 PSI. Adjustment screw for easy adjustment of reduced pressure setting.



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Cross-Section of Protector Installed

What if a seam lets go?

If the plate at the girth seam or rear head seam of a riveted HRT boiler becomes weak through overheating, it incurs the hazard of opening up under pressure. That's a danger which every boiler inspector understands.

By insulating the overlapped edge of the plate and shielding it from direct impingement of blaze, a National Seam Protector prevents buckling, cracking, oxidation, and leaking. This prolongs the life of the boiler and tends to avert the risk of explosion due to seam failure.

It's well for boiler owners and insurance men to be fully informed on National Seam Protectors. Drop us a line now for explanatory literature.

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WANTED
MECHANICAL ENGINEER

Engineers wanted for research and development work on dust collectors, fly ash precipitators, scrubbers and other types of air cleaning devices. Experience and interest in this type of work is desirable. Excellent opportunities. Employer is well established, progressive and expanding manufacturer. Seventy (70) years in Detroit area with plants in central states and on west coast. Modern plant facilities and offices, excellent working conditions and steady employment. Write giving full details.

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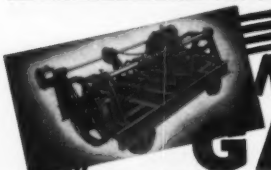
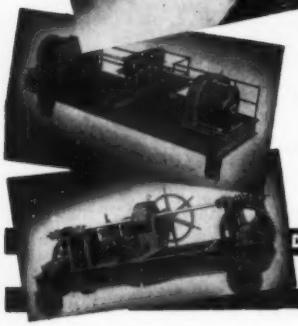


MURRAY GATES and GATE HOISTS

DESIGNED AND BUILT to meet all REQUIREMENTS for any Size Power Dam



From the smallest hand operated, to the large motor operated, MURRAY Gate Hoists are designed and built in a wide range of capacities, from less than 1 ton to over 100 tons. During our over half century of designing and building gate hoists, we have developed many designs for the different types of gate hoist problems. Perhaps we have several designs and patterns that will fit your requirements. In planning gates or gate hoists, we suggest you communicate with us before your plans for the project as a whole, are complete . . . it will save expense and much preparation time. We also build gate hoists especially from your plans and specifications, if desired.

Our Engineering Department is at your service any time, to help you solve problems involving Power Dam Gates and Gate Hoists.

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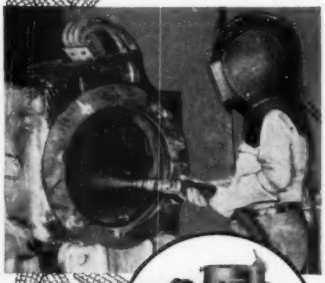
It's "CORNY"

...but it's the best way to CLEAN motors, generators, turbines!



PANGBORN AC-4 Blast Machine

- *CUTS DOWN-TIME*
- *CLEANS WITHOUT SOLVENTS*
- *ELIMINATES DRYING*
- *ELIMINATES TOXIC AND EXPLOSIVE DANGERS*

THE new Pangborn AC-4 Blast Machine cleans motors, generators and turbines faster . . . cleaner . . . and lets you use them sooner because there's no waiting for parts to dry. In fact, dangerous solvents that can lead to explosions, caustic action, and toxic poisoning are completely eliminated!

The AC-4 uses soft, 20-mesh corncob grits to rapidly remove dirt, grease, old paint, etc., in one-third the time, and at 90% less cost than old-fashioned methods. GET FULL DETAILS . . . write, telling us what you clean, to: PANGBORN CORP., 90 Pangborn Boulevard, Hagerstown, Md.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment

Pangborn
BLAST CLEANS CHEAPER
with the right equipment for every job

A new concept in Pneumatic Control:

The Taylor TRANSET* Control System

- **MORE ACCURATE MEASUREMENT**
- **CLOSER CONTROL ON ANY PROCESS**
- **CONTINUOUS SPACE-SAVING RECORDS**
- **HIGHER PROCESSING EFFICIENCY**

Taylor has developed a new controller and a new recorder to take full advantage of faster measuring devices, such as TRANSAIRE* Temperature and Pressure Transmitters and the Aneroid Manometers for Flow and Liquid Level. Each takes advantage of the other's superior performance. **Now available in a complete system.** The result—unprecedented quality of process control.

1. FASTER MEASURING INSTRUMENTS. Taylor's TRANSAIRE, force-balance temperature or pressure transmitters, created new standards in the measurement of *changing or dynamic* temperatures and pressures. With derivative action (SPEED-ACT*) in the measuring system, they transmit process changes with unbelievably fast accuracy. Many other features.

2. FASTER CONTROL with Stability! Taylor's new TRI-ACT* Controller combines a wider range of response adjustments, an increased capacity relay air valve, and a *new control circuit*, to take advantage of the faster measuring systems. This new force-balance controller permits 4 times faster reset rate and 4 times faster rate action (PRE-ACT*) than conventional controllers. No overpeaking. Faster recovery for load changes on pressure, flow, and temperature applications—because rate action is in *the new circuit*.

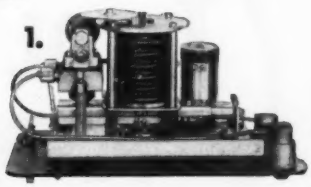
3. MIDGET RECORDER saves space. New TRANSET Recording Receiver greatly reduces panel space. Fits 3⅞" x 4½" panel opening, making it especially adaptable to graphic panels. Gives continuous 30-day process record, with 3 hours visible—remote setting of control point—automatic to manual control—instant check on controller performance and the control valve position.

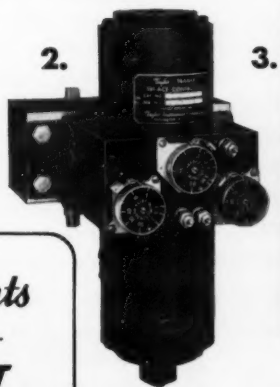
We sincerely believe this new Taylor-engineered TRANSET Pneumatic Control System combines *the best transmitter, the best controller, and the best recorder* on the market. Find out more about it, and put it to work for you! Write for **BULLETIN 98097,** and ask your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

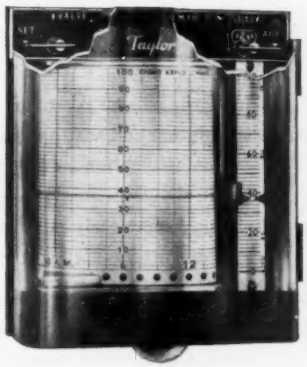
Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

TRANSAIRE ➔ TO TRI-ACT ➔ TO TRANSET

*Trade-Mark







1. TRANSAIRE force-balance temperature or pressure transmitter with SPEED-ACT gives rate action in the measuring circuit. **2. TRI-ACT Controller.** Has high capacity relay air valve for faster response to new control circuit. Wider response adjustments. **3. TRANSET Recorder.** Fits 3⅞" x 4½" opening . . . a "natural" for graphic panels; a great space saver for conventional panels.

Taylor Instruments
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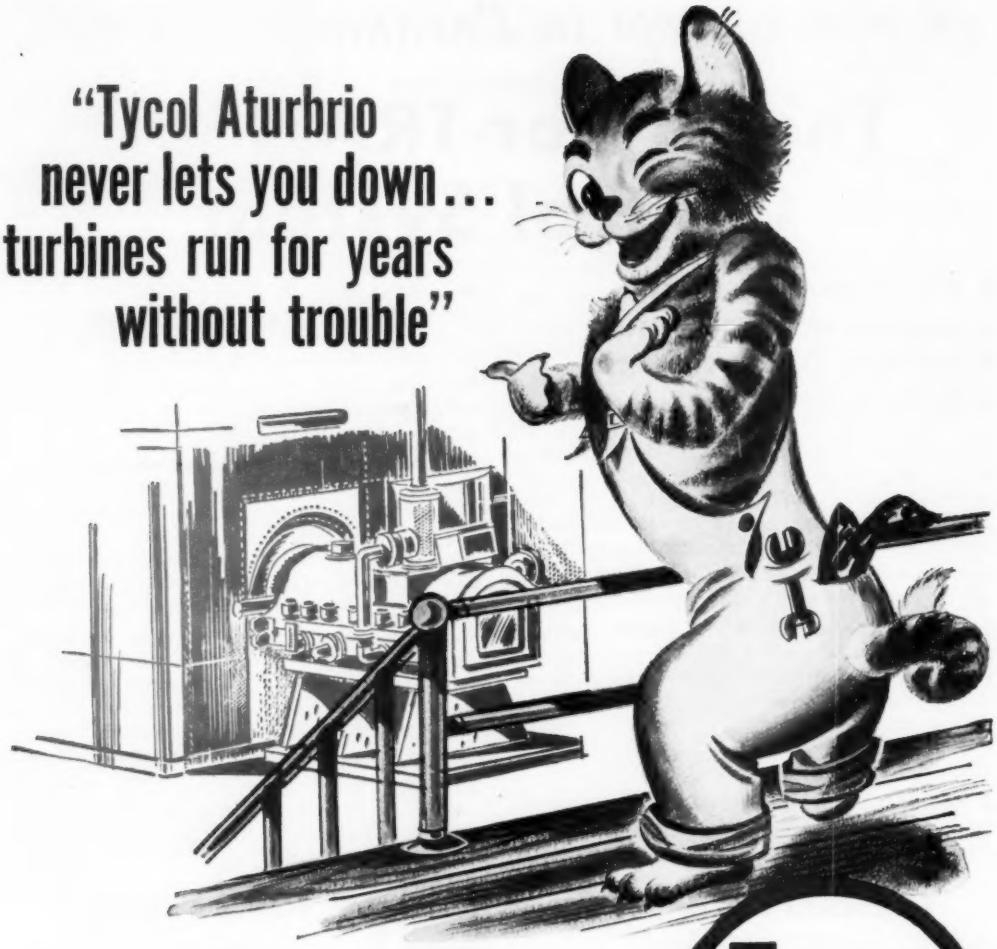
ACCURACY FIRST
IN HOME AND INDUSTRY

"Tycol Aturbrio never lets you down... turbines run for years without trouble"



How true! Tycol Aturbrio Oils are "double inhibited" to prevent oxidation and rusting. They provide maximum resistance to emulsification . . . permit continuous operation without sludge formation — performing for years without an oil change, completely eliminating, in many cases, down-time-high-cost maintenance.

Complete and detailed information on Tycol Aturbrio Turbine Oils is available from your nearest Tide Water Associated office. Call or wire today.

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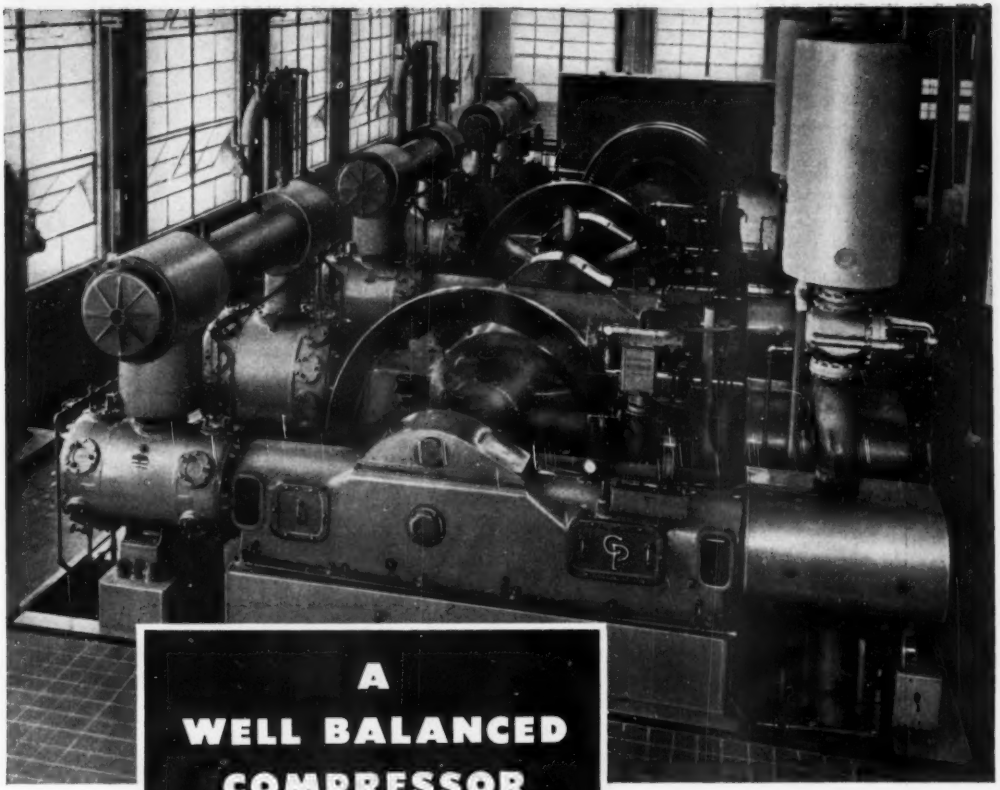

A WELL BALANCED COMPRESSOR INSTALLATION

This CP installation in one of the country's largest automobile plants — three 500 horsepower compressors, one motor-driven and two steam-driven — is a good example of effecting heat balance.

Such combinations of steam and motor-driven compressors provide a desirable flexibility of operation and reduce power costs particularly in plants where exhaust steam can be utilized for process work or for heating.

CHICAGO PNEUMATIC TOOL COMPANY
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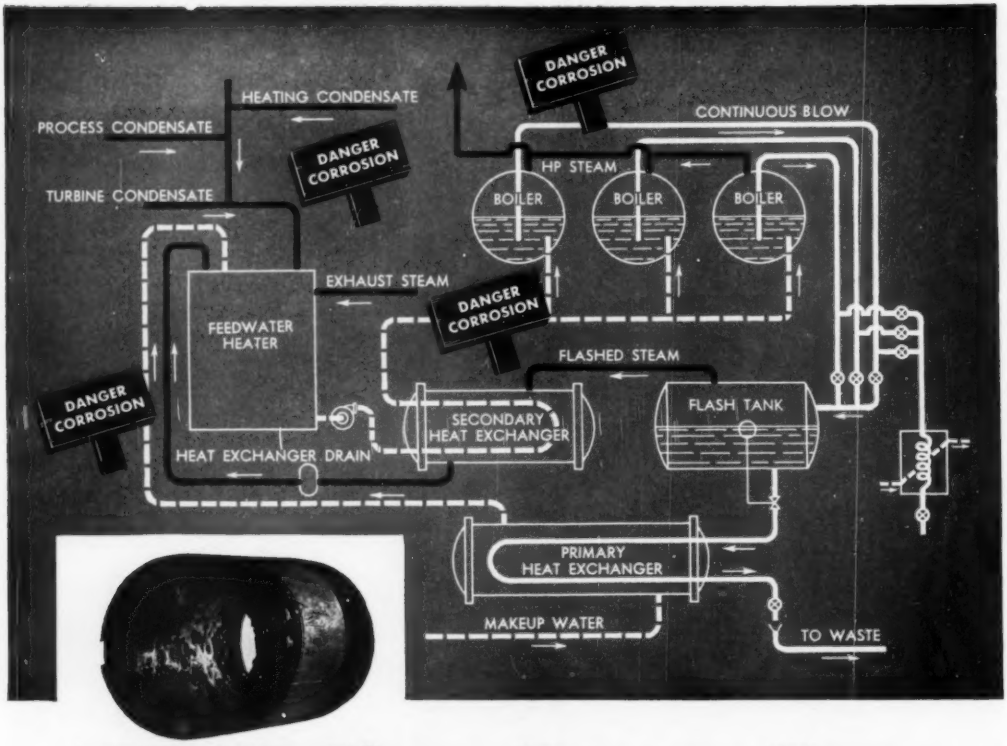

AVOID These Danger Signs with BIRD-ARCHER Amine Treatment

CORRODED condensate return lines lead to expensive pipe replacement and maintenance. As an added annoyance, the solid products of corrosion often plug return lines and fill traps. You can steer clear of these troubles by using the *effective, economical* Bird-Archer Amine Treatment.

HERE'S THE WAY THIS B-A TREATMENT WORKS

Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself.

HERE'S HOW THIS B-A TREATMENT SAVES MONEY

Raising the pH value of the condensate severely decreases maintenance costs by eliminating corrosion. These savings may more than offset the amount of treatment required to provide protection for your equipment.

NEW BULLETIN gives full details on the Bird-Archer Amine Treatment. . . . contains case histories that prove its successful application in many plants. *Write for your copy today.*

BA-154

WHAT AMINES ARE

Amines are members of a class of chemical compounds in which one or more hydrogen atoms of the ammonia molecule are substituted by an organic group. Some of the simpler types are soluble and volatilize from boiler waters. The alkalinity of the amines is an inherent property and does not result from decomposition. *No free ammonia is released.* In the concentrations necessary for protection of condensate systems, amines are harmless to non-ferrous metals, non-toxic and are completely stable at temperatures approximating 675F.

BIRD-ARCHER WATER TREATMENT

THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, Coburg, Ontario
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IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.

take a good look at the Walworth "500 Brinell" no. 225P Globe

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227 P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

note these 7 Great Features

HEXAGONAL UNION BONNET CONNECTION, DEEP STUFFING BOX AND RUGGED STUFFING NUT: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,000 psi.

WALWORTH

valves and fittings

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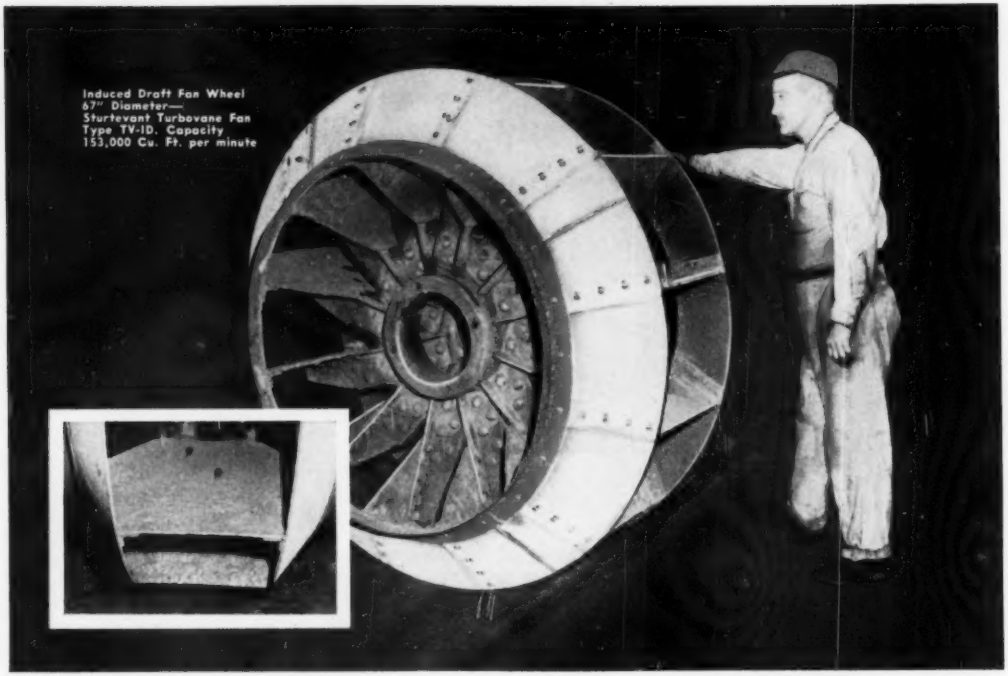


LIFE OF ID FAN BLADES HARD-FACED WITH COAST METALS ALLOY INCREASED FROM 4 to 12 MONTHS

2 Weeks Boiler Outage Eliminated With CM-112 Alloy

Maintaining this 67" induced draft fan wheel at New Jersey Power & Light Company's Gilbert Station in Holland, N. J. always meant one week of boiler outage three times a year. Labor involved in removing the wheel, changing over and reblading took two weeks for each overhaul. Now this is done only *once a year* by hard-facing the fan blades with Coast Metals Alloy 112. This has reduced downtime better than 66% and eliminated 2 weeks of boiler outage at the station.

Fly ash in the exhaust handled by the fan not only wears down the blades but also attacks the junction points of the blades and shrouds weakening the assembly. In this severe case of abrasive action, CM-112 applied to the major points of wear has increased equipment life better than 3 to 1. Coated with 250 pounds of CM-112, the fan lasts one year before major overhaul. Minor touchups during the year are made while the fan wheel remains in the housing . . . on the job.

After one year of operation, the fan wheel can be refaced again . . . this time with about 60% less than the amount of CM-112 used in the initial hard-facing, resulting in a further reduction in maintenance costs.

There are many other examples of how CM Alloys extend the life of power plant equipment subject to impact and abrasion: Raymond Bowl Mill parts—coal feeder screws — sluice liner castings — clinker crusher rolls—impact mill plows—ID fan float liner plates, exhauster fan blades, when hard-faced with CM *stay on the job* and continue to perform efficiently *long after* unfaced parts have become too worn to use and must be replaced.

So don't *replace — reface* with CM specialized welding rods. You'll not only keep your plant running with fewer interruptions, but save money. We shall gladly make recommendations based on your particular needs.

COAST METALS, Inc.

Little Ferry, N. J.

COAST METALS (CANADA), LTD., Hamilton, Ontario

PRODUCERS OF SPECIAL HARD-FACING ALLOYS FOR THE POWER INDUSTRY

third control?

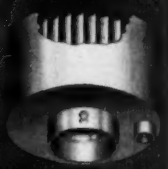
• Frequently you give serious thought and attention to *pressure* and *temperature control*. This is quite natural because it means better operation and more production and often prevents damage. But what about the *third control—entrainment control*. Lack of this control can be just as costly as lack of pressure and temperature control.

Lack of the third control can mean shut downs and loss of production due to entrainment wear in engines and process equipment. Larger slugs of entrainment have been known to blow off cylinder heads of reciprociting engines and to ruin thrust bearings of turbines.

Lack of third control means poor efficiency of superheaters, steam ejectors, dryers and other equipment. It means dirty pipe lines and fouled valves.

End this damage *once and for all* with Hi-eF Purifiers. They remove 99% of all entrainment. Individually guaranteed, Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than an ordinary separator. Write us today about your entrainment problem. Let our engineering staff, without the slightest obligation, give you the proper solution.

ANDERSON
Hi-eF
PURIFIERS



PURIFIER DIVISION,

THE V. D. ANDERSON COMPANY

1934 West 96th Street • Cleveland 2, Ohio

Gentlemen: Please send additional information on Anderson Hi-eF Purifiers.

Name .....

Company .....

Address .....

City ..... **Zone** ... **State** .....

1995

HERE'S WHY

no other coupling costs as little to use as *FAST'S*

With Fast's Couplings you get the lowest coupling cost per year that modern engineering can provide—*because Fast's normally outlast the equipment they connect.* That means their cost can be spread out over 20 years or more!

As two users recently said:

"We've had this Fast's Coupling since 1930 . . . and it's apparently going to last forever. [Wish] the other equipment caused as little trouble!" . . . "We have two Fast's Couplings . . . they are the only equipment so trouble-free we long ago forgot we had them!"

If you want lower costs, freedom from coupling shutdowns and dependable coupling engineering—specify Fast's. For complete details, mail the coupon for Fast's free catalog. Do it today!

RUGGED CONSTRUCTION:

Fast's still maintains its original design, without basic change or sacrifice in size or material. This assures you freedom from needless and expensive coupling failures.

FOOLPROOF DESIGN:

Instead of perishable oil seals, Fast's Couplings use a permanent metal-to-metal closure to keep dust out and oil in. Oil is always maintained at a safe level whether the Fast's is running or standing still.

FREE SERVICE:

When you specify Fast's Couplings you get Koppers' valuable free coupling service. If your application seems to need a special coupling, Koppers' engineers in many cases can easily modify a standard Fast's Coupling, and save you money!

MAIL COUPON TODAY FOR FREE CATALOG!

KOPPERS CO., INC., *Fast's Coupling Dept.,*
222 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

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Company .....

Address .....

City ..... Zone ..... State .....

KOPPERS

FAST'S

THE ORIGINAL GEAR-TYPE

Couplings

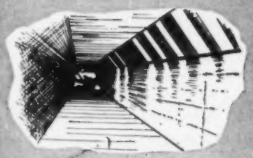
INDUSTRY'S STANDARD FOR 31 YEARS

WHERE TO USE LUMNITE IN POWER PLANTS

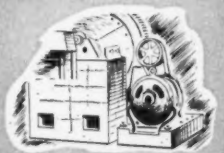
Steel Stack Linings

Ash Pit and Cinder Catcher Linings

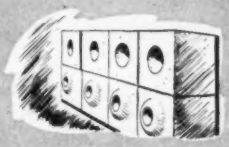
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

Linings made with LUMNITE*

PUT NEW LIFE IN OLD STEEL STACKS

A Lumnite-Haydite lining gives this National Tube Company stack a new lease on life. One of five stacks recently lined, it is now protected against corrosion and the abrasive action of high-velocity gases and fly ash, especially in the breechings. Drafts will be boosted, too, because the lining is smooth and jointless, with good insulating qualities.

Stacks are just one of the profitable uses for insulating concrete made with Lumnite calcium-aluminate cement. Lumnite, with suitable aggregates, is ideal for baffles, furnace walls, arches, door linings...virtually anywhere that heat is a problem.

Easily Installed—Maintenance Reduced. Lumnite linings may be readily troweled into place or "shot" on by cement gun. Thus, there are no small units to work loose; maintenance is lessened. When repairs are necessary, they can be made quickly and cheaply, for Lumnite reaches full service strength in 24 hours or less.

For further information, write Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-40R

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Introducing
A NEW MEMBER OF THE INCO FAMILY INCOLOY

Incoloy is a wrought nickel-chromium-iron alloy, developed as a nickel-saving companion to Inconel. It is a high temperature material with good resistance to oxidation, strength at elevated temperatures and workability comparable to that of Inconel.

The principal engineering characteristics of Incoloy are:

- **Oxidation Resistance** – the oxidation resistance of Incoloy is of the same order as Inconel. It has a chromium content of 21%.
- **Physical Constants** – Physical constants are similar to type 330 stainless steel.

INCOLOY
Mechanical Property Ranges of Standard Forms at Room Temperature

Form & Condition	Tensile Properties: Tensile Strength 1000 psi	Yield Strength (0.2% Offset) 1000 psi	Elongation in 2 in. per cent	Hardness: Brinell 3000 kg	Hardness: Rockwell
Rod and Bar					
Cold-drawn					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-drawn	100-150	80-125	30-10	180-290	90B-30C
Hot-Rolled					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-rolled	80-120	35-90	50-25	135-220	74-96B
Forged	80-120	35-90	50-25	135-220	74-96B
Wire					
Cold-drawn					
Annealed	75-105	25-55	50-25	.....	.....
Plate					
Hot-rolled					
Annealed	75-105	30-55	50-30	120-180	.....
As-rolled	80-120	35-90	50-25	135-220	.....
Sheet					
Cold-rolled					
Annealed	75-100	30-55	50-30	.....	88B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Strip					
Cold-rolled					
Annealed	75-100	30-50	50-30	.....	84B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Tubing					
Cold-drawn					
Annealed	75-100	30-55	50-30	.....	88B (max.)

- **Expansion co-efficients**—The expansion co-efficients are approximately those for Inconel. Thus Incoloy should have about the same high temperature resistance to cracking under drastic temperature changes. Because of its relatively high nickel content (34%) the structure of Incoloy is stably austenitic showing no tendency to become embrittled by precipitation of sigma or carbidic phases after prolonged exposure to intermediate temperatures.
- **Room temperature properties** – Room temperature mechanical property ranges of Incoloy mill forms are shown in the table on the left:
- **High Temperature Properties** – High temperature strength properties of Incoloy are comparable to those of Inconel.

In terms of behavior in various high temperature environments it is anticipated that Incoloy will be superior to Inconel in resistance to sulfidation, green-rot and molten cyanide salts. Incoloy is comparable to Inconel in resistance to oxidation.

- **Work Hardening**—The rates of work hardening of Incoloy and Inconel are practically identical.
- **Annealing** – Annealing temperatures for Incoloy should be within the range of 1800° F. to 2000° F.
- **Fabrication**—Incoloy is workable, both hot and cold. It is machinable, though high-speed steel tools should be used.
- **Welding** – For metal arc welding, "132" Inconel electrode is recommended for all gauges. For inert gas metal arc, "62" Inconel filler wire is recommended. Sheet or strip up to ¼" may be joined by this method.

Forms supplied – Incoloy is produced in the usual mill forms – billets, rounds, flats, hexagons, sheet and strip, tubing and wire.

For additional information on Incoloy write to our Mr. R. F. Johnson.

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INCONEL® • INCONEL "X"® • INCOLOY® • NIMONICS

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Western Precipitation pioneered and installed the first commercial application of the well-known COTTRELL Electric Precipitator—Dr. Cottrell, the inventor, being a member of the company. And for more than 42 years Western Precipitation has consistently led in developing new COTTRELL advancements and techniques for recovering suspensions from gases, both wet and dry.

This 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C 103.

28 PAGES
of helpful facts to know about
COTTRELL ELECTRICAL PRECIPITATORS

Packed with helpful COTTRELL Information!

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Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

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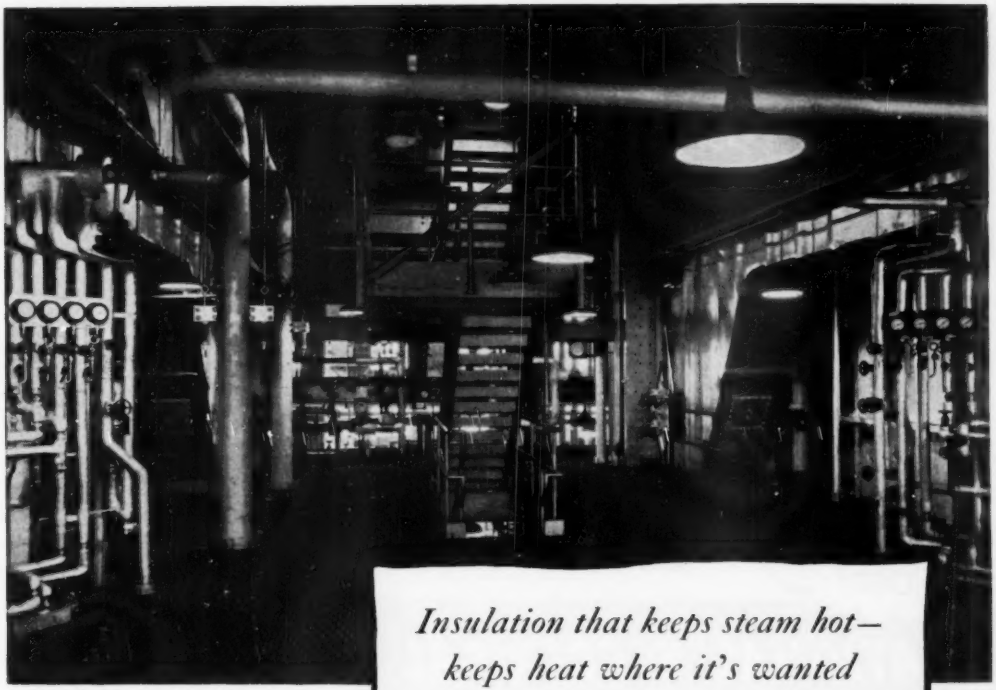

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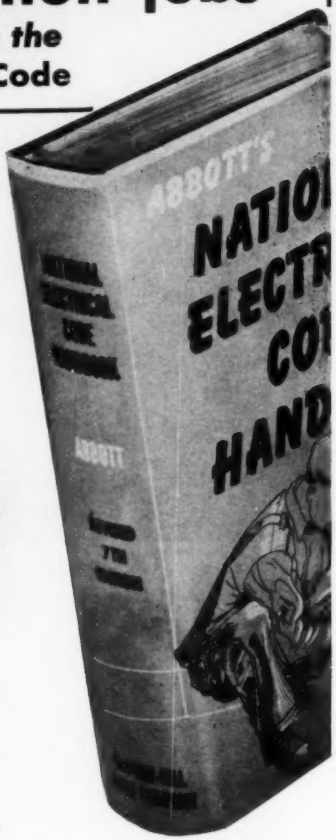
How to handle all types of wiring and installation jobs

in strict accordance with the 1951 National Electrical Code

Here is the electrical contractor's job book completely revised to conform with the 1951 Code requirements and planned to enable electricians to understand and do work in accordance with the National Electrical Code. In Abbott's Handbook, you will find explanations of the rules and measurements for the various types of jobs—what they mean—how to apply them. With it, you can refer to any point about a wiring or installation job by means of the key on the cover and flyleaf—and have the full assurance that no rule which relates to the subject has been overlooked. Wherever a ruling in the Code lacks clarity, it is carefully reviewed and its practical application is explained. More involved Code paragraphs have been divided into short and simple rules; the order of some paragraphs and sections has been changed for easier reference; and many rules have been restated in simple language. Diagrams, sketches, and illustrations are used freely to help you understand the rules quickly and easily.



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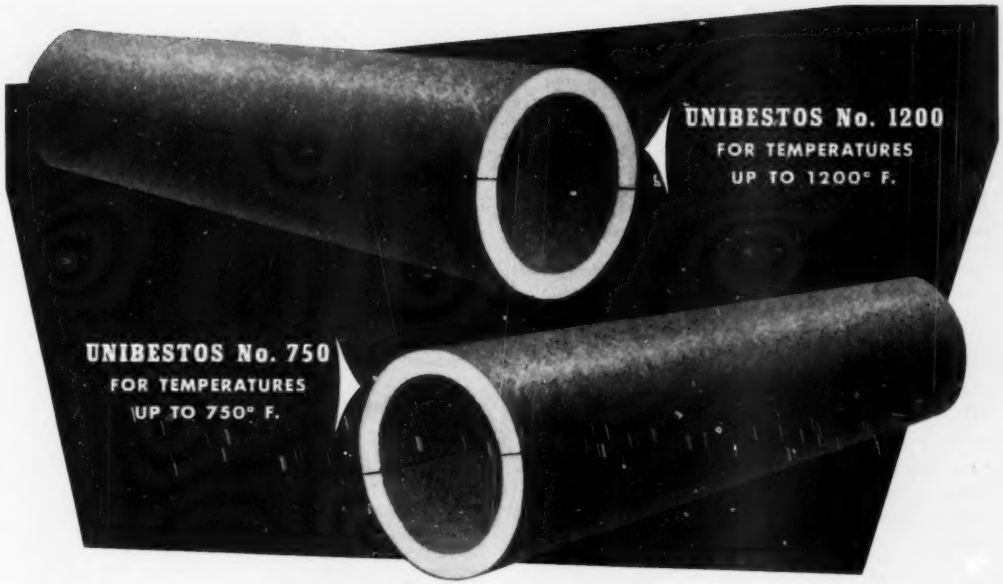

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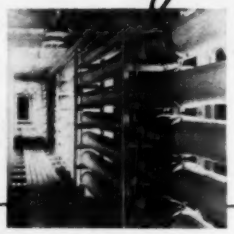

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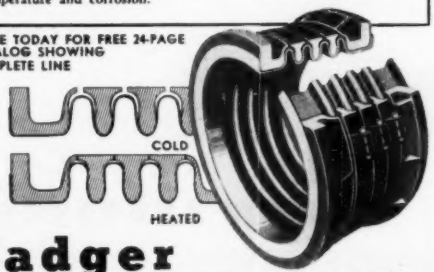

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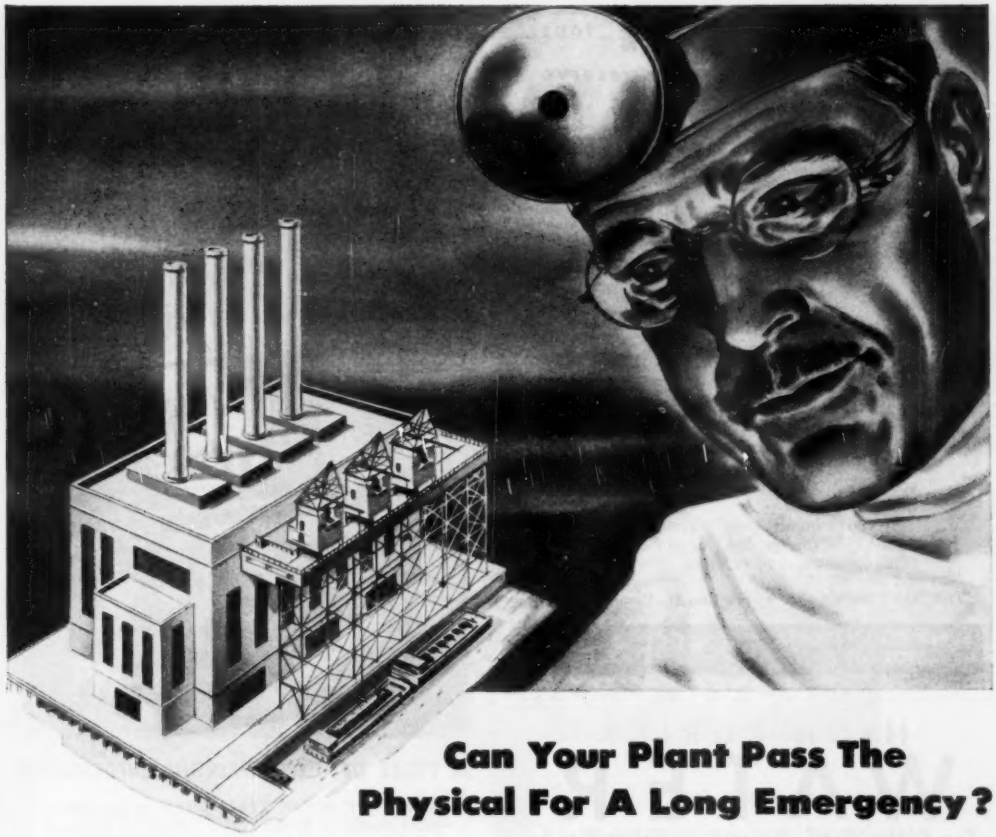

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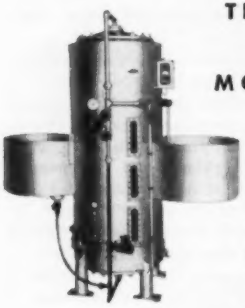

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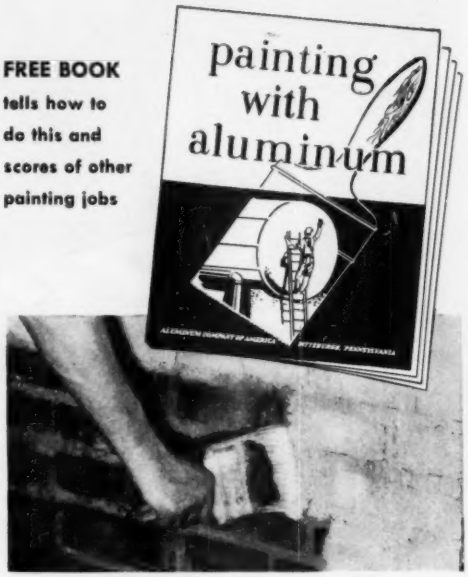

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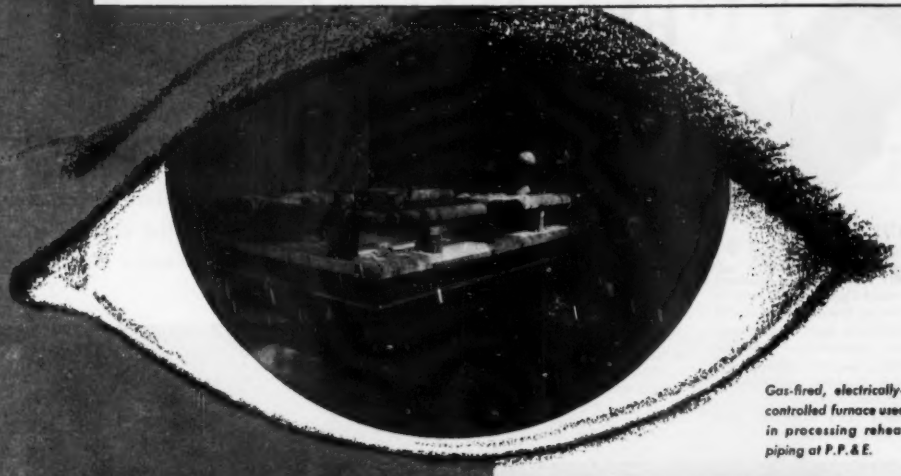

Gas-fired, electrically-controlled furnace used in processing reheat piping at P.P.&E.

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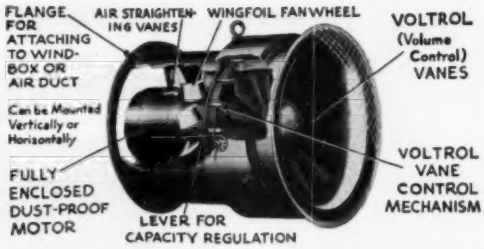
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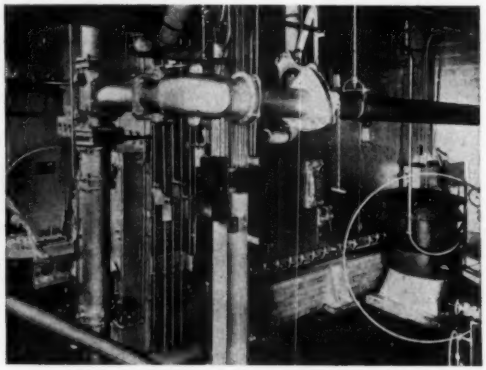

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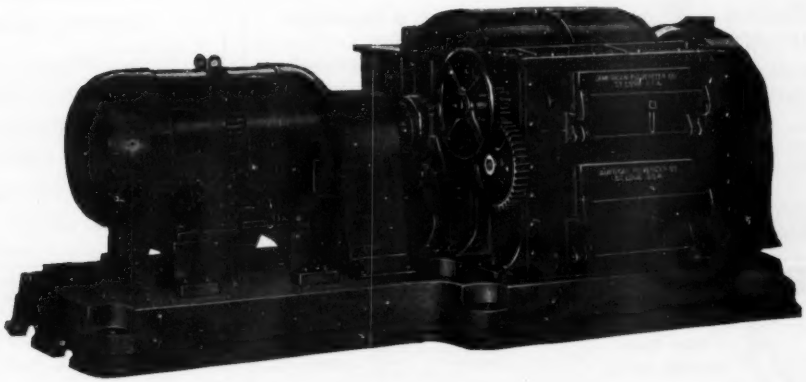

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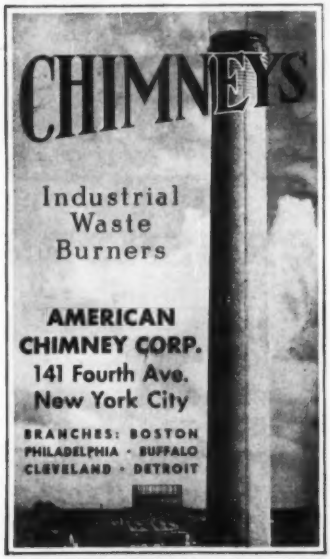

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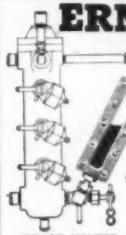

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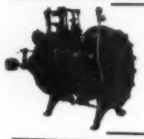

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HOW TO HELP BRITAIN ...and Ourselves

The purpose of this editorial is to help Winston Churchill obtain the aid Britain needs

(1) to weather her present financial crisis, and

(2) to avoid a chronic recurrence of such crises.

This is not a philanthropic purpose.

Britain is our staunchest ally in the free world's continuing fight for survival. She cannot perform her role effectively if she is broke, or if she careens from one financial crisis to another.

Then, too, a nation such as ours—committed to private enterprise as a way of economic life—has a special interest in helping Winston Churchill to help Britain. His administration is relatively friendly toward private enterprise. Should he fail, he would be replaced promptly by a Socialist government more hostile than ever. And that would weaken the standing of private enterprise in the free world.

Cause of the Crisis

It is the drive of the Western World under our leadership to rearm against Russian aggression that has precipitated Britain's financial crisis. It set off a scramble for raw materials from which armaments could be made, and for many other materials that might be short in the event of war. So the prices of the things that Britain must import—mostly raw materials—have been boosted more than the prices of things she can export—mostly finished products. That leaves Britain short of funds to pay for essential imports. This difficulty increases as the necessity becomes more urgent to divert industrial effort from production for export to production for security.

The Basic Trouble

Although Britain's immediate crisis was touched off by the rearmament drive of the Western World, her basic affliction is one from which she has suffered since the end of World War II. Stated in its simplest terms, Britain does not produce enough goods to pay her own way as one of the family of free nations.

For years this deficiency in home production was made up by income from shipping and overseas investment. But Britain had to sell a large part of her foreign investments to finance her heroic part in World War II. So her income from that source has been greatly reduced. And, in spite of an increase of about a third above prewar in her own production of goods and—thanks to a continued "austerity" program—a much larger increase in her exports, Britain still is not paying her own way.

Two Ways to Solvency

Britain has two ways to restore her solvency. One is to cut down on what is consumed—the belt-tightening process. The other is to step up British production.

To surmount the present crisis, Mr. Churchill has asked for some cutting down. He probably must ask for more.

Except as a stop-gap expedient, however, more cutting down of Britain's consumption is clearly a dangerous course. That would further depress a British standard of living which, not more than half as high as ours, already is too low. Politically such a course would grease the skids for Winston Churchill's administration, even now governing by a wafer-thin parliamentary margin. Also, as *The* (London) *Economist* remarks, the "lazy expedient of cutting trade" would result in "hurting other people and forcing them to take similar action"—by cutting the market for their products.

The Only Cure

The best and, in fact, the only way to help cure Britain's economic ills is to help Britain produce more. Here the technical possibilities are encouraging. On the average, the British industrial worker produces only about 40 percent as much a year as the American worker. That is a British estimate, made by Sir Ewart Smith.

Wider use of better industrial methods and modern tools and an infusion of the competitive incentive into British industry — to replace the cartel and other restrictive practices — would go a long way to narrow this wide gap in worker productivity. This is the consensus of experts on both sides of the Atlantic.

Since 1948 the Anglo-American Council on Productivity has done much to encourage output per man-hour in Britain and to foster this doctrine with both labor and management. But much yet remains to be done.

In the United States it is increasingly suggested that before we give Britain any more economic aid we should insist that everything possible be done to exploit the technical possibilities of increased production. This emphasis on production is needed. But if we Americans were to impose upon the hard-pressed British people conditions that could be construed as an affront to a friendly and sovereign nation, we might well put into the hands of a masterful rabble-rouser such as Aneurin Bevan, the anti-American leader of the Labor Party's left wing, a campaign issue on which to maneuver himself into the Prime Ministership.

Churchill Can Insist

But Winston Churchill is not so handicapped as we should be in imposing prerequisites of further aid. As Britain's own, most honored leader he will raise no touchy questions as to Anglo-American relations if he insists that Britain have firm plans to cure her economic ills, plans sharply focussed on ways and means of increasing Britain's industrial efficiency.

By presenting a convincing plan to cure Britain's recurring crises through greater production, Mr. Churchill will greatly facilitate the process of getting the aid his country must have. He will also remove an increasingly dangerous element of dissension in Anglo-American relations – the feeling of many Americans that more aid to Britain is more money down the drain. The way to counter that feeling is to come up with a prescription for an economic cure, not a request for another economic poultice.

Technically, such a program is entirely feasible. It will perhaps be the supreme test of Winston Churchill's statesmanship to make it politically feasible as well.

In the interest of Britain, of the United States and of the whole free world, we wish him all success.

McGraw-Hill Publishing Company, Inc.

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LOCATION: Pennsylvania.
ADVANCEMENT: Excellent for growth on job and promotion in near future
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EDUCATION: B.S. degree in Mechanical (preferred) or Electrical Engineering from an accredited engineering college.
AGE: 30-45.

Salary commensurate with qualifications.
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MOTOR GENERATOR SET
3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	300	600	6600/11000
1	1500	G.E.	720	600	6600/13200
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4400
1	1000	G.E.	720	600	2300/4600
1	1000	G.E.	900	200	6600
1	1000(3U)	G.E.	900	250	2400/4800
2	500	Whse.	900	250	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G.E.	720	125	2300/4600
1	400	G.E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	400	G.E.	900	275	2300/4150
1	350	G.E.	900	125	2300/4150
1	240	G.E.	1200	250	2300
1	300	A.C.	1200	240	2300
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	900	125/250	2300
1	125	G.E.	1200	125	440
1	100	G.E.	1170	125	230
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440

*25 Cycle

ROTARY CONVERTERS
60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—	2000	G.E.	514	600	13800
1—	1000	Whse.	900	600	11000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2500 3/60-Exc. & Surface Cond.
1	2500	G.E.	Auto. Ext. Cond. 800 lbs.-600* F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond.
2	1000	G.E.	Non-condensing, 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G.E.	Condensing 425#-725°TT ISP-440 V. 3 ph. 60 cy Now—1944
1	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter
2	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60
1	400	Whse.	Non-condensing 125/150# ISP 5/10# G.B.P. 240/480v. 3 ph. 60 cy.
1	500	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 125/250V. D.C.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.

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D. C. MOTORS

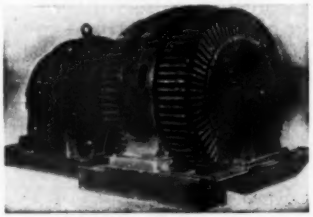
Qu.	HP	Make	Type	Volts	Speed
1—	2200	G.E.	MCF	600	360/500
1—	1750	West.		600	325/720
1—	1500	Whse.		525	600
1—	940	Whse.	QM-R. Brg.	250	140/170
1—	800/1000	Whse.		450	400/720
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	300/400	G.E.	DYNA	250	1325/2500
1—	350	Cr. Wh.	CCM-151H	230	1100
1—	325	Whse.	MQ	250	300/900
1—	200/300	G.E.	MPC	230	360/920
1—	250	G.E.	MPC	230	400/500
1—	150	G.E.		600	250/750
10—	150	Cr. Wh.	83H	230	880
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	780/850
1—	50/120	G.E.	MPC	230	210/1000
2—	100	Whse.	SK-181	230	450/1000
4—	75	G.E.	TLC-50	230	850/2500

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	2000	G.E.	25/60	4000/2300x2300/4000
1—	1000	G.E.	25/58	4400/2300
1—	500	A.C.	25/60	11000/2300V

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed
1	5000	Whse.	2400/4800	600



500 KW MG SET
IN STOCK

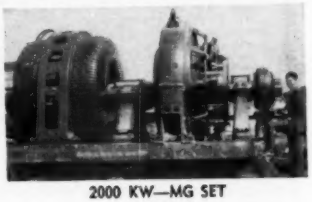
TRANSFORMERS
60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Pitts.	OISC	3	13200x4600/2300
1	1250	Whse.	OISC	3	13200x525/460
3	1000	G.E.	H	1	2200x480
3	1000	Pitts.	OISC	1	22900x13200/2300
3	1250	G.E.	H	1	6600x550
1	500	Whse.	OISC	1	34650x432
1	500	Whse.	OISC	3	13400x216
3	500	Al. Ch.	OISC	1	13200x2300/575
3	333	Whse.	OISC	1	44000/22000x2300
3	200	Whse.	OISC	1	44000/22000x2300
9	300	G.E.	HT	3	2400x240/480
3	150	Whse.	OISC	1	34500x220/440
3	100	G.E.	OISC	1	2400x120/240

RECTIFIERS

Qu.	KW	Make	Type	Volts	Speed
1—	750	G.E.	BHW	575	2300
1—	1000	A.C.	B-612	625	13500
1—	1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.



2000 KW—MG SET
IN STOCK

A. C. MOTORS
3 ph. 60 Cycle
SYNCHRONOUS

HP	Make	Type	Volts	Speed
3—3500	G.E.	TS	2300	257
2—2000	Whse.		2300	120
2— 900	Al. Ch.	(New)	2200	150
3— 735	G.E.	ATI	2200/12000	600
1— 850	Whse.	G	2300	138
1— 500	G.E.	TS 7657	2400/4800	600
1— 450	Whse.	Eng.	2200	128.5
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 100	Whse.		550	600
1— 100	F.M.		220	1200
1— 100	E.M.		440	600
1— 85	G.E.	TS	440	1800

SLIP RING

1—	500	Whse.	CW	550	350
2—	500	G.E. unused	M-574Y	2200	900
1—	500	G.E.	IP	550	505
1—	500	G.E.	IM-Mill	2200	450
1—	500	G.E.	IM	440	900
1—	350	G.E.	MT442-Y	2200/1000	253
1—	300	Al. Ch.	3 Brg.	2300	505
4—	300	G.E.	ITC-5017	550	585
1—	300	Al. Chal.	ANY	2200	708
1—	250	G.E.	MT-424Y	4000	257
1—	250	G.E.	MT-559B	2200	1750
1—	200	G.E.	MTP	440	1170
3—	200	G.E.	IM-17	440	580
1—	150 new	Whse.	CW	2300	450
4—	125	G.E.	MT-566Y	440/2200	435
1—	100	G.E.	IM-16	2200	435
2—	100	G.E.	IM	440	600
3—	100	Al. Ch.	ANY	440	695
1—	100	G.E.	MT556	2200	900
1—	75	Whse.	CW-761	2200	1725

SQUIRREL CAGE

3—	650	G.E.	FT559BY	440	3750
2—	450	Whse.	CS	2300/4150	354
1—	300	G.E.	KT-574Y	2300	585
1—	300	G.E.	IK-17	440	580
1—	200	G.E.	KT537	440	1800
1—	200	G.E.	IK	440	865
1—	150	Waghse.	C8356S	440	880
1—	125	Whse.	MS	440	485
1—	125	G.E.	KP-TEFC	440	3585
2—	125	Al. Ch.	ARW	2200	1750
1—	100	G.E.	IK-Vert.	2300	450
1—	100	G.E.	KT-513	220/440	1750

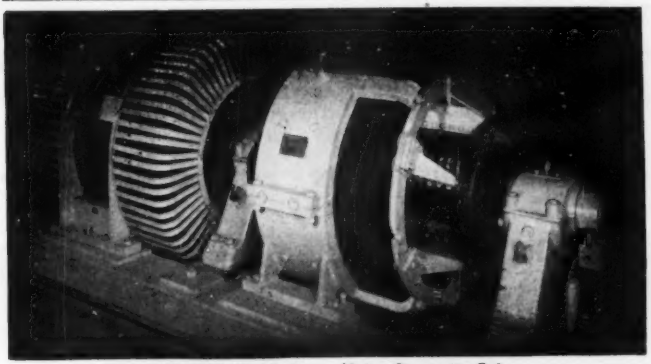
American Rebuilders Association — Member Body of A.S.A.

BELYEA COMPANY, INC.

OFFICE AND SHOP

43 HOWELL ST., JERSEY CITY 6, N. J.

PHONE
JO 2-3334
N. Y. CITY LINE
RE 2-7150



500 K.W. Westinghouse Motor Generator Set

MOTOR GENERATOR SETS
Philadelphia Stock

1—1500 KW GE MPC 300 V 5000 Amp.—2150 HP ATI-Syn Motor, 3/60/4000 Volt. Available immediately.

1—1000 K.W. Westinghouse 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Motor .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels Modern Unit—Can furnish 60 cycle 2300 or 13200 volt.

1—600 KW G.E. MPC—2400 amp. 230 volt 514 RPM with 1050 H.P. G.E.—ATI Syn. Motor .8 P.F. 2 ph., 60 cy., 2300 V. A.C. & D.C. Panels. Can furnish 3 ph. 550 V. or 2300 V.

1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #2813O447-48 (year 1935) See actual photo above.

1—500 K.W. Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.

1—400 KW West. 500 Volt D.C. Any A.C. Voltage with 500 HP West. 350 RPM, 500 Volt Motor for complete drive.

1—360 KW GE CY 125, 180 Volt, Sep. Exc., 1200 RPM, 500 HP Syn Motor, 3/60/2300. 1942.

1—300 K.W. West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.

1—300 K.W. Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM—Automatic Controller & D.C. Panel.

2—150 K.W. G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.

1—100 K.W. Al. Chalmers 250 Volt 1200 RPM 150 H.P. Syn. Motor 2/60 or 3/60 any voltage.

1—100 K.W. G.E.—C.D.—125 Volt D.C. 150 H.P. GE Syn. Motor, 3/60/220/440/1200 RPM.

1—75 K.W. Burke 250 Volt, 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 phase, any voltage.

2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.

Smaller Sizes and Types—Advise Requirements.

DIESEL GENERATORS

2—1250 KVA GM 3/60/2300/720 RPM complete Plants—Used 4 years.

1—1000 KVA Hamilton 99 DA 3/60/2300/4160 600 RPM—New 1943—Never used.

1—625 KVA Baldwin—Series 600 3/60/2300/514 RPM—New 1948—1500 hours.

1—225 KVA GM, Twin 671, 3/60/440. New 1941.

DIESEL AND GASOLINE GENERATOR SETS

2—1250 KVA West. Gen. Mtrs. 16 Cylinder 3/60/2300. Complete plant.

1—225 KVA Electric Machinery A.C. 3 phase, 60 cycle, 230 or 460 volt, 900 RPM direct connected to 300 HP General Motors twin series 6-71 heat exchanger cooling diesel engine mounted on common fabricated steel baseplate, with switchboard panel. Complete with A.C. and D.C. panels.

1—125 KVA Electric Machinery Manufacturing Co. (NEW) Generator, 3 phase, 60 cycle, 120/208 volts, 900 RPM direct connected to 150 HP Cooper Bessemer Model BN-8, 8 cylinder, 4 cycle, Bosch Injection Diesel Engine (Rebuilt) electric starting less battery, includes self-contained A.C. instrument panel and automatic voltage regulator. Complete with A.C. and D.C. panels.

3—125 KVA Murphy Diesel Generator Sets, Model ME-6, 3/60/220 or 440 volt, 1200 RPM, heat exchanger cooled, electric start—with A.C. switchboards—1943.

1—62½ KVA Cummins Diesel Generator, 50 KW, .8 P.F. 3/60/220-440 1200 RPM direct connected to 90 HP Model HMR, 6 cylinder, 4 cycle 4⅞" x 6", 1200 RPM engine with steel base, regulator, electric start and including A.C. switchboard, automatic voltage regulator. Complete with A.C. and D.C. panels.

1—60 KW Westinghouse Type SK, 230 volt, D.C. Generator, 1350 RPM direct connected to 94 HP Cummins Diesel Engine Model HMR, 6 cylinder, 4 cycle, 4⅞" x 6", 1350 RPM on steel base, radiator, electric start—portable or stationary. Complete with A.C. and D.C. panels.

1—56.3 KVA General Electric Generator, 45 KW, .8 P.F. 2 or 3 phase, 60 cycle, 220 volt, 1200 RPM with Climax Model TU-75 gasoline engine, all on cast iron base. Radiator, switchboard-electric start. Complete with A.C. and D.C. panels.

2—New 45 KVA Chrysler Diesel Generators, Model IMD, 6 cylinder, Bosch Injection, 3 phase, 50/60 cycle, 1500/1800 RPM, 220-440 volt radiator, switchboard, voltage regulator-portable. Complete with A.C. and D.C. panels.

ELECTRIC MOTORS

Q.	H.P.	Make	Type	Volts	Speed
3	500	West.	CS	6600	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	West.	Syn.	2300	1200
1	150	Ideal	Syn.	220	1200
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1800
2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	50	West.	CS	440	3600

AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 Lb., direct 250 H.P., 440/3/60/3600.

1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 950 HP Syn. 1 P.F. 2300/60/3.

1—4690 CFM I.R. PRE-2, 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.

1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.

2—1400 CFM Sullivan WJ 3 Angle Cpd. 100 psi 22/13x16 belt.

2—1200 CFM I.R. 22/13x16 100 psi belt.

1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.

1—734 CFM Sullivan W-13 13/13x8 60 lb. belt.

1—528 CFM CP NSB 14x12 100 lb.

1—371 CFM Schramm 7¼/5x4 100 lb.

2—368 CFM I.R. ER-1 12x10 100 psi.

1—350 CFM I.R. type 40 7/6½x5 air cooled 125 lb. direct 75 HP 220/440/60/3 870.

1—327 CFM Sullivan type WL-60 100 psi.

1—233 CFM Penna. 3A 10x8 70 lb.

1—173 CFM CP NSB 9x8 100 lb.

1—173 CFM Penna. 3A 9x8 100 lb.

1—122 CFM Worthington 7x7 Horiz. 100 lb.

2—80 CFM CP 6x7 TB 150 lb.

1—40 CFM I.R. Type 30 80 lb. Tank mtd. 7½ HP

3—21 CFM Curtis CJ-1000, 3 stage 850 lb.

5—16.86 I.R. Type 30, 3½/2x5 400 lb.

100—10 CFM I.R. Type N 26 lb. or 25" Hg. Vacuum.

CENTRIFUGAL PUMPS

Q	GPM	TNH	Description	Size	HP	Speed
2	10,000	200'	LeCourtenay	20"	624	870
2	10,000	100'	LeCourtenay	20"	350	870
2	8,150	200'	LeCourtenay	16"	550	1180
1	8,000	110'	Worthington	14"	200	1200
2	7,000	200'	LeCourtenay	16"	423	1000
1	6,000	110'	Ingersoll-Rand	12"	500	1200
1	4,000	110'	Ingersoll-Rand	12"	500	1200
1	3,500	47'	Southwalk	12"	75	870
2	1,700	95'	De Laval	10"	60	1750
1	1,550	231'	Allis-Chalmers	8"	150	1750
1	1,200	40'	Worthington	6"	15	1730

TURBO GENERATORS

1—625 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.

1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.

2—300 K.W. West. Non-Cond. 3/60/440 125 psi 5 B.P. New 1938

1—300 KW West. 3 wire 125/250 Volt D.C., Non-Cond. Turbo Units 125 PSI, 5 lb. B.P. New 1938—(See Actual Photo.)

1—75 KW G.E. Non-Cond. D.C. 125 volt.

1—35 KW G.E. Non-Cond. D.C. 125 volt.

BOILERS (ASME)

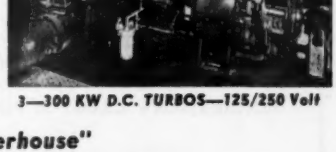
1—106 H.P., Keeler, Self-contained, 125#

2—240 H.P., Keeler, Horizontal, Long-Drum, Water Tube, 200#

1—250 H.P., Bigelow, Self-contained, 125#

2—360 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr., Water wall, 250#

1—390 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr. Water wall, 300#



3—300 KW D.C. TURBOS—125/250 Volt

"Everything from a Pulley to a Powerhouse"

SINCE 1915

THE O'BRIEN MACHINERY CO.

T.M. REGISTERED U.S. PATENT OFFICE

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PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

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SOC EXPANSÃO INDUSTRIAL SUL AMERICANA LTDA

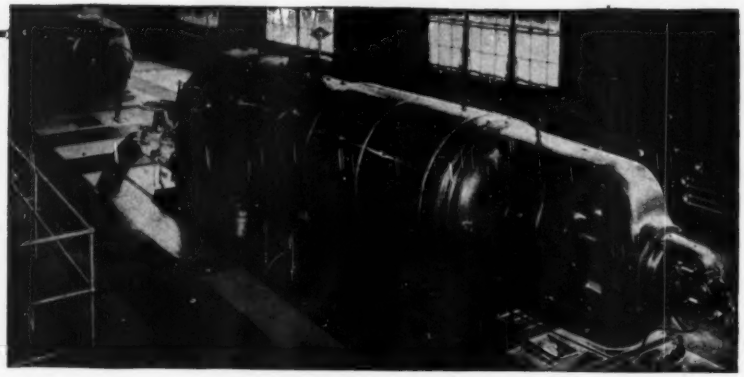
RIO DE JANEIRO — BRASIL

2500 KW. @ .80, 3125-KVA.

TWO (2) GENERAL ELECTRIC TURBO-GENERATORS

VERY HIGH GRADE UNITS: Are Duplicates

WILL PASS RIGID INSPECTION



Above View shows our Two (2) General Electric Turbo-Generators on present Foundations. They are 2500 KW @ 80% PF, 3125 KVA, both are complete units with (2) Surface Condensers, Exciters, and all auxiliaries. Steam 160/225# psig, 450° FTT, 2300, 4160, 6900 V.

FREE BULLETIN #900 in Colors has specifications and Complete Data on above Units. SEND FOR IT TODAY.

A PARTIAL LIST OF TURBO-GENERATORS IN OUR STOCK IS GIVEN BELOW

12,500-KVA G.E., CONDENSING Complete A-1

6,250-KVA G.E., Complete Condensing Unit Condition: Excellent. 200# PSIG, 2300/4160 V. High Grade Unit

3,750-KVA G.E. 150/250# PSIG, 480 Volt Limited use since Rebuilt A-1

3,750-KVA G.E. modern 440# PSIG, 750° FTT 2300 Volt. Rare unit

3,125-KVA 160/225# psig, 2300 Volt
See above Cut and description (2)

3,125-KVA G.E. 200# psig, 2300 V. OK

2,500-KVA G.E. 150/200# psig, 2300 V

2,500-KVA, Westg. 250/350# psig, 2300 Volt. Non-cond. Like New Unit. Back P. 40/50#. Modern. Any Insp.

1,875-KVA Allis-C, 150-200# psig 2300 V. Rebuilt by Allis Co.

1,875-KVA Allis-C, 150/250# psig 2300 V. Very Good

1,250-KVA, Allis-C, 200# psig. Rebuilt Excellent condition A-1

937-KVA G.E., 150# psig, 480 V. Rebuilt

1,000-KVA 440# psig, 750° FTT, Condg. New, never uncrated G.E. 480 V.

937-KVA Allis-C, 125/200# psig 480 V. Rebuilt, New Coils No. 1

625-KVA, Westg. 250# psig, Non-cond. 125#. B.P. Like New Machine

625-KVA, G.E., 125/175# psig, 480 V. A-1

WE OWN ALL ABOVE TURBINES. ARE IN STORAGE: IMMEDIATE DELIVERY

BOILERS:—WE CARRY A FULL LINE **DIESELS:—WE CARRY A FULL LINE**

SEND US YOUR SPECS.

WRITE,
WIRE OR
TELEPHONE

CHARLES WEAVER, Owner
ELECTRICAL AND MECHANICAL ENGINEERS
4145 PENOBSCOT BUILDING, DETROIT 26, MICHIGAN

TELEPHONES:
WOODWARD 1-1340
WOODWARD 1-1341
WOODWARD 1-8038

GOOD EQUIPMENT • RIGHT PRICES • IMMEDIATE DELIVERIES

here's the reason...

. . . YOUR INQUIRIES ARE PROMPTLY ANSWERED—

FINGERTIP INFORMATION

Our staff is capable of providing you with information and specifications on all types of jobs. From the minute your job enters the door to the day it is shipped a "finger-tip" record is kept to guide it through our plant. Our staff also keeps a running inventory of "stock-on hand" and on available equipment throughout the country to assure fast and efficient fulfillment of your needs.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A PARTIAL LISTING OF OUR HALF-MILLION DOLLAR STOCK

SQUIRREL CAGE
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E. (New)	K63478	1800
750	*G.E.	KT	720
550	*G.E.	KF-559	3600
500	*G.E.	PEG	1800
500	*Fr-Morse	BS	1200
450	*G.E.	KF-5678	1200
400	*Cont. (New)	NZ	1200
400	*G.E.	IK	514
350	*Cr-Wh.	SC	3600
300	*Westgh.	CS	3600
300	West.	CS	514
300	G.E.	IE-K	1200
300	Al.Ch.	AR	900
250	*L.-Allis	OGK-148S	720
250	Al.Ch.	630DSWW	1200
250	G.E.	IK	600
250	Westgh.	CS	600
200	*G.E.	IK-13B	1800
200	G.E.	IK-17	600
150	G.E.	KT-540	1800
150	G.E.	IEK	1800
150	*Al.Ch.	AN	1800
150	*G.E.	IK	600
150	G.E.	IK (550r)	514
150	G.E.	IK	450
125	*A.C.	AR-226	1800
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	U.S. (Vert.)	CFU	1200
100	Al.Ch. (new)	AW	1200
100	Reliance (new)	AAC (TEFC)	1200
100	G.E.	IK15A	1200
100	*West.	CS	1200
75	West.	C8645C	1800
75	G.E.	KT-346	1200
75	Triumph	TR16	514
75	G.E.	IK	600
75	G.E.	IK	514
75	Al.Ch.	AN	1800
60	*Westgh.	C8504	1800
60	A.C. (New)	APZ443S	1800
50	G.E.	KT527	1800
50	U.S. (Vert.)	SCV937	1800

Hundreds of Smaller Motors

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6D8	925 Ft.
500	Manistee	H	250 Ft.
300	Al.-Ch.	NMZ	800 Ft.

ELECTRIC SHOVEL OR CRANE DRIVE

250 V. - VARIABLE VOLTAGE

1—100 KW DC Hoist Generator
1— 25 KW DS Swing Generator
1— 24 KW DC Crown Generator
Driven by
100 HP Syn. Motor, 3/60/2300 v.

MOTORS

1— 75 HP G.E. MDS106 Hoist
1— 30 HP G.E. MD104½ Swing
1— 30 HP G.E. MD104½ Crowd

SLIP RING
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Cr.-Wh.		240
650	Westgh.	HE	350
500	Westgh.	CW	350
400	A.C.	3 Brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	Westgh.	HF15H	600
200	Westgh.	CW	600
200	G.E.	IM	1800
150	Westgh.	CW772C	1200
150	*G.E.	IM-16	600
125	*G.E.	MT-549	1800
125	G.E.	IM17A	600
125	G.E. (New)	M6335Z	900
100	A.C.	ANY	900
100	G.E.	IM	450
75	G.E.	MT547	1200
75	G.E.	MT256	900
75	G.E.	IM	720
75	Star	OSOO	900
75	G.E.	IM-14	600
60	Westgh.	CW762C	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	Westgh.	CW636A	1200
50	G.E.	MT246	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT236	1200
40	Westgh.	CW642C	1200

CHANDEYSSON ANODIZER

NEW 1000 Amp. 40 volt, type NPT, d/c to 60 HP A-28 Syn. Motor, 3/60/220, 600 RPM, 25°C. continuous.

D. C. MOTORS

230 Volts

H.P.	Make	Type	Speed
375	Westgh.	Ped	650
200	Westgh.	SK210	800
175	G.E.	ELC11	750
125	G.E.	Marine	1200
100	G.E.	RC34	2500
100	Westgh.	SK173	850
100	A.C.	E152	575
40	Cr.-Wh.	CMC	1750
40	G.E.	C02004	600
35	Cr.-Wh.	CM351	700
35	G.E.	C	600
30	Westgh.	SK120	975
30	Cr.-Wh.	CCM	450
30	Westgh.	SK933	1750
30	G.E.	RC31B	1150
25	Westgh.	SK113	850
25	Westgh.	SK106L	1100

MANY OTHERS—1 HP and Up! ALSO 115 VOLT

AC SYNCHRONOUS
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	P.F.	Spd.
1420	*Westgh.	Syn.	.7	900
800	G.E.	TS984	1.0	1800
750	*Westgh.		.8	900
700	G.E.	TS	1.0	514
320	*Al.-Ch.	Dr. Pf.	1.0	720
300	Cr.-Wh.	Eng.	1.0	300
300	G.E.	ATI-8	.8	900
250	*Al.-Ch.	Dr. Pf.	1.0	720
220	G.E.	ATI	1.0	600
196	El. Machy.	Ped.	1.0	450
150	*Westgh.	HK	1.0	300
125	Parkinson			900
125	El. Mach.	Syn.	1.0	900
125	Cr.-Wh.	103-8	1.0	900
125	*G.E.	TS	1.0	277
115	E.-M.	EM	1.0	240
100	Cr.-Wh.	103-S	.8	900
100	*G.E.	ATB	.8	900
100	Ideal	8MS	1.0	900
75	G.E.	ATI	1.0	900
40	G.E.	ATB	.8	1200
20	Fynn W.	15VKN		1200
15	Century	AHC265	1.0	1200
4	G.E.	AK (25 cy.)		1500

D. C. MOTORS

ADJUSTABLE SPEED

230 Volts (*115 Volt)

H.P.	Make	Type	Speed
30	G.E.	C	300/900
20	A.C.	ER-145	300/1200
15	*Triumph	Planer	225/900
12.5/15	G.E.	BC-116	500/1500
10/15	Reliance	18JT	400/1600
10	*Elec-D	7½S	300/1200
10	G.E.	RF-11A	300/1200
10	G.E.	RD-10A	600/1800
10	West.	SK-100	400/1600
10	G.E.	CR-10	450/1350

AC SYNCHRONOUS
GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

K.V.A.	Make	Type	P.F.	Spd.
1500	G.E.	ATI	.8	900
1000	*West.	203D	.8	900
250	*Al. Ch. (new)		.8	720
150	El. Mach.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
110	Cr. Wh.	103	.8	900
100	*G.E.	ATB	.8	900
60	Fr.-Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200

1000 KW M.G. SET
3-UNIT

2—500 KW West. DC Gens., 275/137.5 V, 3 wire, 1820 Amps.

D/C TO

1420 HP West. Syn. Motor, 900 RPM 11,000 V. 60 Cy., 3 ph. 3 Brg. on Castiron Factory Base.

MOTOR-GENERATOR SETS

K.W.	Make	A.C.	D.C.
500	Al. Ch.	2300	250
500	Cr.-Wh.	220/440	250
450	G.E. (3 unit)	2300	125/250
400	Westgh.	2300	600
250	West.-G.E.	440	250
200	Cr.-Wh.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	440	250/375
100	G.E.	440	250
100	G.E.	220	250
100	G.E. Delco	440	120/240
75	Al. Ch.	440	250
60	Al.-Ch.	2300	110
40	Cr.-Wh.	220	125
40	Ki-P-GE	440	250
40	Al.-Ch.	440	250
30	Reliance GE	220	250
25	G.E.	440	250
25	Cr.-Wh.	440	125
20	G.E.	440	250
15	G.E.	220	250
10	G.E.	440	125
10	Cr.-Wh.	220	125
10	G.E.	440	250

D.C. TO A.C.

100	G.E.	230	250
75	Westgh.	110	2300

ROTARY CONVERTERS

1000	G.E.	600 v	DC
500	G.E.	600 v	DC

TRANSFORMERS

KVA	Make	Ph.	Prim.	Sec.
2000	Pittsb.	1	12000	2300
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
500	G.E.	3	13200	445
300	G.E.	3	13800	240/480
300	G.E.	3	2400	240/480
167	Al.Ch.	1	2400	240/480
167	Al.Ch.	1	2400	120/240
160	Al.Ch.	1	2400	240/480
100	Al.Ch.	1	2400	120/240
75	Al.Ch.	1	2300	120/240
SMALLER RATINGS			2400 to	120/240

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CHICAGO *Electric Co.*

1320 W. CERMAK RD. • CHICAGO 8, ILLINOIS

ELECTRIC MOTORS AND GENERATORS

WAGNER CERTIFIED REBUILT

BACKED BY 46 YEARS OF QUALITY AND SERVICE

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OVER 46 YEARS OF EXPERIENCE is back of every machine sold by Arthur Wagner Company. Large stocks and modern facilities insure ample choice and prompt service at reasonable cost. All Wagner "Certified Rebuilt" equipment conforms to standards approved by National Industrial Service Association. Inspect our shop and stock—see why it pays to . . . "Check with Wagner First!"

M-G SETS

KW	Mfr.	Input V	Output V
500	Gen. Elec.*	2300 AC	250 DC
500	G.E. HCC contr.	2300 AC	275 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	G.E.*	440 AC	275 DC
200	Whse.*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.*	2300 AC	275 DC
150	Gen. Elec.*	2300/440 AC	600 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	220/440 AC	70 DC
100	Delco	220/440 AC	125/250 DC
100	Allis Ch.* (2)	2200/440 AC	60 DC
100	Gen. Elec.	220/440 AC	125 DC
75	Whse. (2)	220/440 AC	250 DC
75	Gen. Elec. (2)	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
65	Gen. Elec.	220/440 AC	60 DC
40	Gen. Elec.	220/440 AC	550 DC
40	Whse. (2)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
30	Elec. Prod.	220/440 AC	50 DC
25	G.E. b.b. New	220/440 AC	125 DC
20	Northw'n.	220/440 AC	250 DC

*Syn. motor drive.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	Gen. Elec.	CD183A	230	400/1200
200	Gen. Elec.	CD165A	230	850
150	Gen. Elec.	MPC	230	500/1200
100	Whse.	8K181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	Whse. (2)	8K163	230	850
75	Northw'n	K39	230	1750
60	Cr. Wh.	56H	230	700
60	Reliance b.b.	451T	230	750
50	Gen. Elec.	BLC 201	230	500/1200
50	Gen. Elec.	LC	115	400/800
50	Cr. Wheeler	CMC	230	1750
40	Whse.	8K	230	850
40	Gen. Elec.	RC32	550	1200
40	Gen. Elec.	RC-32	230	1150
50	Gen. Elec. (2)	CD115	230	575/1150
25x/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	8K110L	230	1150
30	Whse. (2)	8K90	230	1700
30	Star b.b.	SB	230	1750
25	Gen. Elec.	CD85	230	1750
25	Whse.	8K150	230	500/1200
25	G.E. b.b. New	CDM93	115	1150
25	Gen. Elec.	RF13	230	250/1000
25	Whse.	8K	230	1150
20	Whse. b.b.	8K133	230	450/1800
20	G.E. b.b. (5)	CDM83	230	1150
20	Whse. b.b. (2)	8K97	550	900
20	Gen. Elec. (2)	CD83	230	1750

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC
- FREQUENCY CHANGERS
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1 brg.	DMC	275	720
200	Gen. Elec.	CD	250	1150
150	Whse.	8K191	125/250	900
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
75	Whse.	8K	250	1200
75	Gen. Elec.	RC36	125	1200
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	KW	125/250	1200
50	Cr. Wheeler	50H	250	900
40	Whse.	8K	250	1200
40	Gen. Elec. (2)	RC32	250	1500
40	Gen. Elec.	RC32	550	1500
30	G.E. b.b. New	CDM93	125	1750
25	Whse.	8K	250	1450
20	Gen. Elec. (2)	RC	125	1150
20	Gen. Elec. b.b.	CDM	250	1750
15	Cr. Wheeler b.b.	CCD	125	1100

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg	240/480	900
500	Gen. Elec.	ATB	240/480	900
312	Gen. Elec.	ATB	240/480	600
312	Gen. Elec.	ATI	240/480	900
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
187	Gen. Elec.	ATB	240/480	900
150	Whse.		2300/480	600
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
75	Gen. Elec.	ATI	240/480	1200
56	Gen. Elec.	ATB	240/480	1200
31	Whse. b.b.	late	120/208	1200
10	Kato New (30)	b.b.	127/220	1800

A. C. MOTORS — SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr.	Type	Speed
1—	600	Gen. Elec.	IM	360
1—	500	G.E. 2 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	350	Whse. 2200V.	CW	450
1—	300	G.E. 2300V.	I-M	1800

——	250	G.E. 220V.	IM-17A	600
1—	250	Allis Ch. 2200V.	ANY	514
1—	250	Cr. Wheeler	SR	600
1—	200	Gen. Elec.	I-M	360
2—	200	Gen. Elec.	I-M	600
1—	150	G.E. 2200/4400V. Vert.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	150	G.E.	IM-16	600
1—	150	Allis Ch. 2200V.	ANY	720
1—	125	G.E 2200V.	IM-15	720
1—	125	Allis Ch.	ANY	900
2—	100	Gen. Elec. New	M6324	1200
1—	100	Gen. Elec.	I-M	720
2—	100	Gen. Elec.	I-M	514
2—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT553	1200
1—	100	Cr. Wheeler	SR	600
1—	100	Northwestern	HW	1800
——	75	Gen. Elec.	MT552	900
1—	75	Whse. 2200V.	CW	600
2—	75	Gen. Elec.	MT343	1800
1—	75	Whse.	CW	720
1—	60	Gen. Elec. enclosed	I-M	514
1—	60	G.E. TEFC b.b.	M-6326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CW716C	900
1—	60	Gen. Elec.	MT343	1200
1—	50	Allis Ch	ANY	900
1—	50	Howell	9R437	1200
1—	50	Gen. Elec. Int.	ITC600	600
2—	40	Whse.	CW636A	1200
1—	40	Gen. Elec.	MT552	600
1—	30	G.E. Int. duty	MTC5312	1200
2—	30	Gen. Elec.	MT326	1200
2—	30	Gen. Elec.	MT332	900
1—	25	Gen. Elec. Int.	MTC5326	720
4—	20	Whse. b.b. New	CW364	1800

A. C. MOTORS — SYNCHRONOUS

HP	Mfr.	Type	Volts	Speed
750	Whse. SPF	Cond.	4000/2200	900
700	Gen. Elec.	TS7659	2200	514
500	Gen. Elec.	ATI	220/440	900
375	Gen. Elec.	ATI	550	720
300	Whse.	G	2200/440	600
275	G.E. 25 cycle		220/440	750
250	Burke	2 brg.	2200/440	360
225	El. Machy.	BRKT	220/440	1800
220	G.E. 3 brg. SPF	ATI	220/440	600
220	G.E.	ATI	2200	900
200	Allis Ch. (2)	SPF	2200/440	720
200	G.E.	TS	220/440	150
190	El. Machy.	3 brg.	220/440	514
175	Gen. Elec.	ATI	2200/550	450
175	Whse.	3 brg.	220/440	360
125	El. Machy. (2)		220/440	1800
128	Burke b.b. SFF	AC19	2200/440	1200
100	American b.b.	VGH	220/440	1800
90	Gen. Elec.	TS7545	220/440	1200
80	Gen. Elec.	ATI	2200/440	1300

A. C. MOTORS — SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr.	Type	Speed
1—	500	G.E. 6600/4000 V.	I-K	1800
1—	300	G.E. 2200V.	KTP581	1800
1—	300	Gen. Elec.	I-K	600
2—	250	Whse. 2200V.	CS	1200
1—	250	Gen. Elec.	FT549AZ	3600
1—	250	Gen. Elec.	IK-17	600
1—	250	Gen. Elec.	I-K	720
1—	250	Gen. Elec.	IK-17	514
2—	200	Reliance b.b. New	B6985S	1800
2—	200	Gen. Elec.	I-K	600
1—	200	Gen. Elec.	KT566	600
1—	200	U.S. b.b. New	SC587	1200
2—	200	Gen. Elec.	I-K-E13B	1800
1—	200	Whse. 2200V. Ex. Pf.	CS81208	1200
1—	150	Gen. Elec.	K558	900
1—	150	Allis Ch. 2200V.	AN	3600
2—	150	U. S. b.b. New	SC587	1200
1—	150	Reliance b.b. New	C6085	900
1—	150	Gen. Elec.	KT549	1800
2—	150	Gen. Elec. 2200V.	IK-15A	720
1—	150	Gen. Elec.	IK-16	600
1—	150	Gen. Elec. TEFC b.b.	K6333S	1200
1—	150	Gen. Elec.	IK-17	450
1—	150	Whse.	CS	720
2—	125	Al. Ch. 2200V. b.b	ARX-826	900
1—	125	Rel. TEFC New	B6985S	1800
2—	125	Gen. Elec.	K-558	900
1—	125	G.E. b.b. New	KG324S	1200
1—	125	G.E. New b.b. HT	KG6324	1200
1—	125	Con. 2200V. b.b.	6G	1800
3—	125	G.E. 2200V. TEFC	K6326	3600
1—	125	Reliance b.b. New	B6085	900
2—	100	Reliance b.b New	50848	1800
1—	100	Reliance TEFC New	B5085	1200
1—	100	Whse.	CS	720
1—	100	Rel. TEFC New	5058	3600
1—	100	Gen. Elec.	IK-15	600
2—	100	Gen. Elec.	IK-14	900
1—	100	Reliance b.b. New	C5085	900
1—	75	Whse. Expl. Prf.	CS505	1200
1—	75	Wagner	22VRM	1200
1—	75	Rel. TEFC New	5058	3600
1—	75/90	Gen. Elec.	IK	3600
1—	75	G.E. TEFC 2200V.	K-6325	900
2—	75	Gen. Elec.	KT-14	600
2—	75	Gen. Elec.	KT546	900
2—	60	Howell b.b.	K504	1200
1—	60	Gen. Elec.	KT556	450
1—	60	Reliance b.b. New	CC505	900
2—	60	G.E. Vertical	KT556	450
1—	60	Gen. Elec.	I-K	600
3—	60	G.E. 2200V.	KT536	1200
2—	60	Reliance b.b. NEW	B504	1800
1—	60	Allis Ch. TEFC	ARZ	3600
2—	50	Howell b.b.	8CBB	3600
2—	50	Gen. Elec.	KT546	720
1—	50	G.E. Vertical	KT546	720
2—	50	Reliance b.b. New	CC504U	900
2—	50	Whse	CS	1200
2—	50	Howell TEFC	K445	1800
1—	50	Fair. Morse b.b.	HJ-12D	900
1—	50	Gen. Elec.	KT527	1800
1—	50	Reliance b.b.	C585	600
1—	50	Whse. hitorq	C8505	900
2—	40	G.E. 2200V.	KT323	1800
2—	40	Reliance b.b. New	CB404	1800
1—	40	Louis Allis b.b.	OX404	3600
2—	40	Gen. Elec.	KT532	1200
4—	40	Gen. Elec.	KT336	900
2—	40	Gen. Elec.	KT548	900
6—	40	Whse. b.b.	C8-504	1200/900

A. C. MOTORS — 25 CYCLE

HP	Mfr.	Type	Volts	Speed
275	G.E. syn.	ATI	440	750
150	Whse.	HF	440	500
60	Allis Ch.	ARY	440	1500
50	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750
30	Gen. Elec.	MT343	440	750

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NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof—Geared Head
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
250	G.E.	KT 559	1750
200	Wagner	RP226F	1800
200	Al.Ch. (2)	BB	880
200	G.E.	KF-6335	880
150	West.	CS	1150
150	West.	CS	580
125	Al. Ch. (5)	AR	1750
100	West.	TEFC	3600
100	Al. Ch.	AR	1150
100	West.	CS	870
100	G.E.	IE-K	1800
100	G.E.	K-544	1175
75	West. (2)	CS-654C	1750
75	G.E. (2)	KT347	1150
75	G.E.	IK	900
75	G.E.	KT-352	865
75	West.	CS	720
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel.	AA	875
60	G.E.	KT-346	865
60	G.E.	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E. (2)	KT	1740
50	G.E.	XP	1750
50	G.E.	KF-445	1170
50	West (3)	CS	870
50	G.E. (2)	IK	870

SLIPRING MOTORS
3 Phase

H.P.	Make	Type	Speed
600	Cr. Wh.	131AQ	507
500	G.E. (2)	IM	450
500	Ideal		1150
400	West.	CW	450
400	G.E.	IM	870
250	G.E.	IM	435
225	Wagner	25 cy.	710
200	G.E.	MT559Y	1170
150	Wagner	31VRN	900
150	Burke		720
125	West.	CW	1750
125	Burke		600
100	G.E.	MT347	1150
100	G.E.	IM	690
75	Lincoln	IXM	1750
75	West.	CW	1150
75	West.	CW	720
75	G.E.	IM	690
60	G.E.	MT533	1750
60	West.	CW116	290
50	G.E.	MT-536	1150
50	Wagner		1150
50	L.A.	OGH	870
50	Cr. Wh.		900
50	G.E.	MT546	720
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
200	West. (3)		900
180	G.E.	ATI	900
150	G.E.	TS	900
150	G.E.	TS	720
150	G.E.	ATI	900
100	G.E.	ATI	1200
75	G.E.	TS	900
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
150	G.E.	L.C.	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Cr.-Wh.	53H	850
75	G.E.	RC36	800
75	West.	SK-180	475
75	Cr. Wh.	CMC	875/950
60	West.	SK-160	680
60	West.	SK	250/1000
50	G.E.	CD	3600
50	West.	SK-160	565
50	G.E.	RF-17	250/1000
45/90	G.E.	RF-17	475/1950
40	West.	SK-103	1750
40	G.E.	RC-31	1700
40	G.E.	CD-1441	400/1500
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West.	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	800/1200
25	West.	SK113	850

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CCM	900
40	G.E.	DLC	1150
40	G.E.	RC	1050
40	G.E.	CD-113	850
30	Eck.		950
25	G.E. (2)	CD	1800
25	G.E.	CD93	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
20	G.E.	CD85	1150
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
15	Cr.Wh.	RC	1200
15	G.E.		900
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

HP	Make	Type	Speed
765	G.E. (3)	MPC	1045/1350

AC GENERATORS

KW	Make		Speed
180	G.E.	ATB	900
100	G.E.	ATB	360
40	G.E.	ASI	1200
15	G.E.	ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D.C. Input	A.C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	Ely. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hertner	115	440
6¾	G.E.	230	240
5	El. Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G.E. (4)	1200
325	G.E.	1200
30	Burke	1750
20	Reliance	1150

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
300	Elliott	1200
250 (2)	Cr.-Wh.	1200
250	G.E.	1150
200	G.E.	1200
150	West.	900
125 (2)	G.E.	1200
100	West.	1200
100	Delco	1200
100	G.E.	700
75	G.E.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
150	West. (2)	1200
100	West. (2)	900
100	G.E.	1200
100	El. Machry	1200
100	West.	1200
75	G.E.	1150
50	West. (2)	1150
30	G.E.	1150
30	L.A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
10,000	HVW	6/12
10,000	North.	2½/10
4,000	HVW	6/12
5,000	HVW	6/12
2,500	Chandeysson	6/12
125	Hobart	7½
500	Chandeysson	12
1,000	West. SK	24
1,500	Century	24
2,000	G.E.	24V
100	Hertner	28
150	G.E.	30
200	West.	30
500	West.	32
1,000	G.E.	33
150	Watton	40
1,000	Chandeysson	40
200	G.E.	42
325	West.	50
1,500	G.E.	50
1,500	Century	60
1,500	G.E.	60
1,000	G.E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
5 KVA	West.	400 cy.

ELECTRIC HOISTS

1000# Y & T—D.C.
1000# Thor—Air.
1000# Y & T—A.C.
1000# Shepard—A.C.
2000# R & M—D.C. (3)
2000# C & M—D.C.

GUARANTEE YOUR INVESTMENTS!

- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization —41 years' experience.

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — NEW YORK 13, N. Y.

ELECTRICAL EQUIPMENT
REBUILT AND GUARANTEED
PROMPT SHIPMENT — PARTIAL LISTING

Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—

—Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed

800/1600 AMPERE ARC WELDING MOTOR GENERATOR SETS

Each set consists of two generators and one motor, mounted on base. Each Generator: Northwestern Type K20DR, 800 ampere, 80 volts, 1750 RPM. Motor: 125 HP, Allis Chalmers, Type AR, 2200 volts, 3 phase, 60 cycle, 1750 RPM.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5301
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
1	11½	828	550	G.E.	ITC-5008
2	15	574	220	West.	CW-646
1	18	888	440	West.	MW-316
1	20	880	440	West.	CW-636
1	25	1150	550	G.E.	MT-323
2	25	850	220	Wagner	HH
3	25	720	440	Wagner	22VBB
1	30	855	440	West.	CW-646
1	30	856	440	G.E.	MT-332
1	30	875	440	G.E.	MT-338
2	35	690	440	F-M	HV-H16A
2	40	885	2300	Al. Ch.	ARY-323C
1	40	580	440	G.E.	MT-348
1	50	1150	440	G.E.	MT-336
1	50	880	440	West.	HF-12A
1	50	570	220	G.E.	MT-332
5	52½	550	220	G.E.	IQC-5013***
1	60	885	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	342	550	West.	CW-958
1	80‡	575	440	G.E.	MTC-5353
2	125	430	440	G.E.	IL-16
2	150	1754	440	G.E.	MTP-549
1	175	585	550	West.	CW-1000
1	200	495	2300	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
2	300	900	440	G.E.	IM-17
2	300	880	2300	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
1	400	805	550	West.	CW
1	600	1770	440*	G.E.	IM-E15C
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. **2 phase.
***New. ****2 phase. 1225 cycle.
*Also 2300 volts. †Also 440 or 550 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
2	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	Hp.	Speed	Make	Type
10	½	1750	Reliance	T-257
25	¾	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
3	7½	1150	G.E.	CD-75
10	10**	1750	Rimble	BA-394
5	10**	1150	Al. Ch.	ED-80
2	10	850	West.	SK-83
10	11¼**	600	West.	SK-83
3	15	1750	G.E.	CD-75
3	15	850	West.	SK-90
1	20	1750	G.A.	CON-A-LA51
1	20**	1450	G.E.	CDM-83
1	30	1750/1310	West.	SK-83
2	30	1150	G.E.	BC-30
1	30**	1450	G.E.	CDM-83
11	30	750	West.	SK-110L
17	35	825	West.	SK-120
1	40	1150	G.E.	BC-13
1	40	1760	West.	SK-103
1	40	750	G.E.	BC-34
1	50	750	West.	SK-150
1	50	850	G.E.	BC-16
1	150	700	Al. Ch.	
3	200	1150	G.E.	BC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

Qn.	Hp.	Speed	Make	Type
6	5/7½	600/1800	G.E.	BA-30
1	10	600/1800	Reliance	T-927
1	12½	280/840	West.	SK-130
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	BP-11
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	BP-13
1	25	300/1500	G.E.	BP-12
1	25/29	300/1200	G.E.	BP-13
1	30/40**	400/1600	G.E.	CD-123B
1	35	500/1500	West.	SK-143
1	40/50	400/1200	West.	SK-163
1	75	500/1500	Cr. Wh.	CCM
1	75	375/750	Cr. Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al. Ch.	
1	100	250/900	West.	SK-200
1	125	430/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

**New

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
3	3	1160	440	L.A.	JB-254
4	5	1730	440	G.E.	K-254
2	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CB-324
3	10	1145	440	West.	CR-326-EXP
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-384
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JA-405
1	25	705	440	West.	CB-W504
1	40	3565	440	G.E.	KP-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
1	3	1160	440	L.A.	FB-254
23	5	1750	440	L.A.	FB-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
4	15	1150	440	L.A.	FX-365
1	50	1780	440	L.A.	FX-446A
5	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KP-8335

OPEN TYPE MOTORS

Qu.	HP	Speed	Volts	Make	Type
5	10**	1735	440	Century	SC326
1	15	1360	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-513
1	20**	3475	220	West.	CB-326
1	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CB-W364
1	20	1200	220	G.E.	KT-513
2	20	1160	440	West.	CB-464C
2	20	900	220	G.E.	FTR-523
5	25**	1748	440	Century	SC-364
1	25	1160	440	West.	CB-487C
1	25	900	220	Howell	SCRB-556***
1	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
1	30	2550	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1160	440	West.	CB444
1	30	870	220	West.	CB446
1	40**	3545	220	G.E.	KP-4048
2	40	1750	440	West.	CB-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RPS-405
1	50	850	220	West.	CCL
2	60*	1756	440	Ideal	AH-444
2	60	880	440	G.E.	KT-546
1	75	1160	440	West.	CB-662C
2	75	870	220	West.	CB-766A
2	75	885	2300	G.E.	KT-3521B
1	100	890	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AW
1	100	495	2200	Al.Ch.	AR
1	125	435	440	G.E.	I-17-FR
2	125	400	2300	G.E.	KT-5608
1	200	580	550‡‡	G.E.	KT-5608
2	200	587	2200	West.	CS-39A
1	500	1200	110	G.E.	KTP-567
1	700	1800	2300/ 4000	West.	CS-4-39D12

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

250 VOLT DYNAMOMETERS
Cradle Type With Seals and Control

Qn.	Make	HP	RPM	Type
1	G.E.	150	2200/3000	TLC-50
2	West	150	2200/5000	SK-131
1	G.E.	200	1200	C

MOTOR GENERATOR SETS
125 and 250 Volts D.C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	220/2200
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440†
16	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	Al. Ch.	1750	125	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240
100	West.	1160	125/250	2300/4100

Note: 3KW, 5KW & 7.5KW, 250V Sets Available. **New *Synch. Motor Driven $50 Cy. $25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

AMERICAN
SINCE 1902
COMPRESSORS
VACUUM PUMPS
FINE QUALITY REBUILTS
YOUR CHOICE:
American—Bury—Chicago—
Curtis—Davey—Gardner
Ingersoll—LeRoi—
Penn—Schramm—
Sullivan—Worthington
HEAR-HERE
American Rebuilts
Are Best
AMERICAN AIR COMPRESSOR CORP.
Doll Ave., & 47th North Bergen, N. J.

MOTOR GENERATORS

1—300 KW G.E. Syn. 250 V. 1200 RPM
2—300 KW WEST. Syn. 250 V. 1200 RPM
2—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 900 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
1—100 KW RIDGWAY Syn. 250 V. 1200 RPM
2— 50 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM
2—500 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
2—300 KW Al-Ch Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

COMPLETE DIESEL PLANT

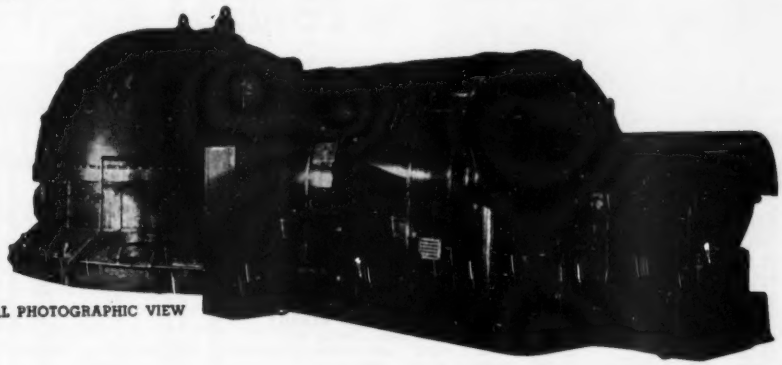
3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

GENERATOR
Suitable for use as
Synchronous Condenser
Rewound & overhauled by GE Co.
(In original crates)
3500 KW, 80% PF., 3/60/2400, 3600 RPM.
Very Attractively Priced for Quick Disposal
STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., N. Y. 33, N. Y.

DIESEL GENERATOR UNITS
AC and DC
Quick Delivery and Complete Installation with all Equipment
LIEFKE, 57-25 Cooper Ave.
Brooklyn 27, N. Y. HEgeman 3-4335

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° T.T. complete with direct connected shaft exciter, switchboard, a 30,000 square foot Westinghouse surface condenser and condensing accessories, including 2—150,000 pounds steam per hour B&W sectional header cross drum boilers, 250# pres., 550° T.T. equipped with Taylor retort stokers.



ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4000 volts, 200# P.S.I., 600° TT.

4000 KVA Allis, 2300 volts, 150-200 PSI.

3750 KVA Westghse. 2300 volt, 200 PSI.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator LESS TURBINE.

2500 KVA Westghse. 2300 volt, 250 PSI.

1563 KVA Allis, 600 volts, 200 PSI.

1250 KVA G.E. AUTOMATIC EXTRACTION BLEEDER 2300 volts, 250 PSI.

937 KVA Allis, 480 volts, 250 PSI.

780 KVA Allis, 480 volts, 150 PSI.

625 KVA G.E. 480 volts, 150 PSI.

Non-condensing—3 phase, 60 cycle

940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.

625 KVA G.E. 480 volts, 125-150 PSI, 20# back.

375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.

250 KVA Allis 480 volts 125 P.S.I.

125 KVA G.E., 2300 volts, 150-200 PSI.

125 KVA Westghse. 2400 volts, 150-250 PSI 10# back.

Direct Current

500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.

100 KW (2) G.E., 125 volts, 200-275 PSI.

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing.

MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, alternator connected 135 HP, 250 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

50 KW G.E. 125 volt direct current 1200 RPM to a 3 phase, 60 cycle, 220 volt syn. motor.

10 KW G.E., 125 volt direct current to a 3 phase, 60 cycle, 220 volt motor.

February BARGAINS
SPECIALLY PRICED

547 HP, 250# pres. and three 400 HP, 225# pres. B&W water tube boilers.

8000 sq. ft. Wheeler, 4400 sq ft. Worthington, 2000 sq. ft. Worthington and one 1500 sq. ft. Westinghouse surface condensers.

4900 GPM and 3500 GPM Allis 2-stage pumps, 130 ft. hd. each direct connected 400-325 HP Allis 3 phase, 60 cycle, 2300 volt motor.

1250 KVA E.M. 3 phase, 60 cycle, 4000/2300 volts synchronous generator direct connected 38D8-1/8 O.P. Fairbanks Diesel Engine.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I., G.E. turbine.

25 HP G.E. 60 cycle, 220 volt, 1170 RPM totally enclosed fan-cooled motor.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Syn. (condenser).

900 HP Allis, 2200 volts, 150 RPM.

UNAFLOW GENERATOR UNITS

625 KVA G.E. 240 volt generator connected 29"x36" Skinner horizontal engine, 150 PSI complete.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal engine, 125-150 PSI.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

60 KVA G.E. 240 volt 300 RPM generator connected Skinner engine 125 P.S.I.

Direct Current

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.

250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.

20 KW Allis 125 volt generator connected Hill vertical Diesel engine.

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
400	G.E.	I-M	1200	S. B.
300	G.E.	I-M	1200	S. B.
200	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1800	S. B.
100	G.E.	MT-300	1800	S. B.
100	G.E.	I-M	900	S. B.
180	G.E.	I-M	720	S. B.
75	G.E.	MT-343	1200	S. B.
75	G.E.	I-M	900	S. B.
75	West.	CW	720	S. B.
75	G.E.	I-M	720	S. B.
60	G.E.	MT-333	1800	S. B.
40	G.E.	I-M	1800	S. B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
150	G.E.	K-5326	3600	TEFCBB
150	G.E.	K-5328	1800	TEFCBB
125	G.E.	K-5529	1200	TEFCBB
100	West.	CS-5078	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QB-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	CS-5048	1800	TEFCBBXP
60	G.E.	K-5048	1800	TEFCBBXP
60	L.A.	BQ-44	1800	B. B. open
60	F.M.	QR-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-5045	1800	TEFCBBXP
40	A.C.	AR-444	3600	TEFCBBXP
40	G.E.	KF-3655	3600	B. B. splash
40	West.	CS-406	1800	TEFCBB
40	L.A.	K-406	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open
40	Cr. Wh.	BC-445	1200	TEFCBB
30	G.E.	KF-3455	3600	B. B. splash
30	West.	CS-3455	3600	S. B. splash
25	Line.-Weld	DBD-328	3600	B. B. open
25	West.	CS-364	1800	S. B. splash
25	G.E.	K-364	1800	S. B. drip
20	G.E.	K-364	1800	S. B. drip
20	L.A.	EX-364	1800	TEFCBBXP
20	G.E.	KF-404	1200	TEFCBBXP
20	G.E.	KQ-405	600	TEFCBBXP
20	G.E.	KF-405	900	TEFCBBXP
15	L.A.	EX-328	1800	TEFCBBXP
10	West.	CS-294Z	3600	TEFCBB
10	Howell	EKBB-28-S	1800	TEFCBBXP
10	Wallace	AA-CB-324	1800	TEFCBB
10	West.	CS-324	1800	TEFCBB
10	West.	CS-324	1800	B. B. open
10	L.A.	EX-326	1200	TEFCBBXP
10	G.E.	K-364	900	S. B. drip
10	L.A.	R-1838	600	TEFCBB
3	G.E.	K-224	3600	TEFCBBXP
3	L.A.	EX-225	1800	TEFCBBXP

SQUIRREL CAGE MOTORS REBUILT

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
250	Wagner	RP-2-26	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-584	900	S. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1200	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	K-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-348	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25R	1800	S. B.
50	G.E.	KT-337	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.
50	G.E.	KT-342	900	S. B.
50	G.E.	KT-346	900	S. B.
40	G.E.	K-444	1800	B. B.
40	G.E.	KT-323	1800	S. B.
40	West.	CS	1200	S. B.
40	G.E.	KT-335	900	S. B.
40	F.M.	B-H12D	900	S. B.
40	G.E.	KT-542	720	S. B.
35	Triumph	B-12	900	S. B.
35	G.E.	I-L	900	S. B.
35	G.E.	I-K	720	S. B.
30	G.E.	KT-312	1800	S. B.
30	West.	CS	1200	S. B.
30	G.E.	KT-332	900	S. B.
25	G.E.	KT-312	1800	S. B.
25	West.	CS-471	1800	S. B.
25	Century	SC-30	1200	S. B.
25	G.E.	I-K	720	S. B.
25	F.M.	B-H12-B	720	S. B.
20	West.	CS-364	1800	S. B. splash

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.
We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

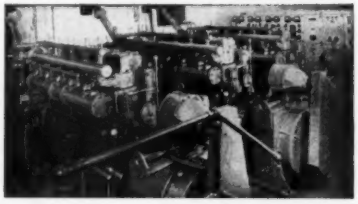
8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.
Telephone: Genesee 5629

375 KVA - FOR SALE - 300 KW
WORTHINGTON-WESTINGHOUSE
INSTALLATION

COMMERCIALLY UNUSED

•

IMMEDIATE DELIVERY



Each Plant consists of

3 Worthington Model BB 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

OWNED & OFFERED BY

KANE-McGUIRE COMPANY

Single units available

1492 East 32nd Street
Brooklyn, New York
PHONE: WHitehall 3-6843

TURBO-GENERATORS

250 KW, 300 KW A.C. and D.C.

2000 KW 3 phase, 50 cycles, 6300 volts

Immediate delivery

Packed in original crates

Complete Specifications and Details Upon Request

INTERNATIONAL FERMONT MACHINERY CO., INC.
115 BROADWAY
NEW YORK 6, N. Y.

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all RE-MANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

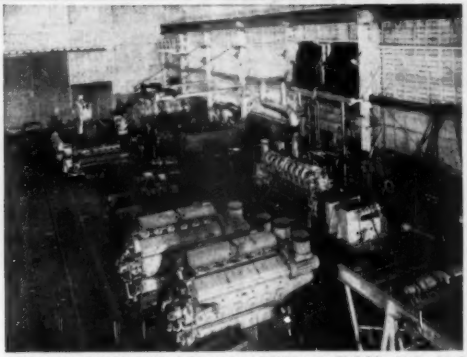
Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G. SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1230	Nordberg	F6G168SC	1750	327
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	Alco	6-12-1/2x13T	750	600
500	Worthington	EE	750	327
500	General Motors	8-567	720	720
340	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
300	Enterprise	DSG-6	450	450
300	General Motors	8-268A	450	1200
264	Superior	KNA	396	514
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
100	General Motors	3-268A	150	1200
100	Worthington	88-5	150	600
60	General Motors	6-71	90	1200
50	Caterpillar	D-8800	76	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

Most all units still on foundation. Many may be seen operating

DIESEL UNITS

100 KVA (2) GE-Nordberg
1000 KVA Elliott-DeLaverne
375 KVA (2) GE-DeLaverne VD
375 KVA Fairbanks-Morse 32E14
353 KVA (2) Fairbanks Morse 32D
312 KVA (2) Wghse-Worthington
250 KVA Fairbanks-Morse 32E14
250 KVA GE-Buckeye-E
187 KVA GE-Buckeye-E
175 KVA Fairbanks-Morse 32E14
125 KVA GE-General Motors
90 KVA Fairbanks-Morse 32E14
75 KVA (2) General Motors
62 KVA International Harves. (package)
50 KVA (2) Fairbanks-Morse 42F
225 HP Buckeye (belted)
180 HP Fairbanks-Morse (belted)
128 HP (4) Caterpillar (belted)
120 HP Fairbanks-Morse 32E

GAS ENGINE UNITS

1000 KVA (2) GE-Nordberg
750 KVA Elec. Mchy.—800 HP Worthington Nat. Gas

BOILERS

427 HP Bigelow 3 dr. 200#
395 HP Union 3 dr. type L, 300#
370 HP Wicks Cr. drm. (2) 300#
333 HP Bigelow 3 drm. 250#
309 HP Combustion 3 dr. 160#
285 HP B&W 3 dr. 250#
255 HP (2) Combustion 200#
220 HP (2) Vogt 3 dr. 160#
Three 250 HP HRT 150#

TURBO GENERATOR UNITS

3750 KVA Wghse. 3/60/600 v; bleeder
2800 KVA GE 3/60/2300 v; non-cond.
1250 KVA GE 3/60/480 v; bleeder
937 KVA Wghse. 3/60/480 v; bleeder
750 KVA AL-Chal. 3/60/480 v; cond.
625 KVA GE 3/60/480 v; cond.
2800 KVA GE 3/60/2300 v; non-cond.
250 KVA GE 3/60/600 v; non-cond.
187 KVA GE 3/60/480 v; non-cond. 375#
SURFACE CONDENSOR 4000 Sq. Ft. Wghse.

ENGINE-GENERATOR UNITS
3/60/480/240 v.

312 KVA GE-Skinner unif.
250 KVA (3) Elec. Machy.—Skinner unif.
187 KVA Wghse.-Ames vertical
62 KVA GE-Ames Unif.

Above listed units are only a few of our "SPECIALS." Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type Engine
650	138	2300	Whse.	80%
400	900	2300	Whse.	80%
250	200	440	G.E.	85%
150	600	440	G.E.	100%
100	900	440	G.E.	100%
75	1200	440	G.E.	80%

SLIP RING

HP	RPM	Volts	Mfg.
700	514	2300	G.E.
500	1200	220/440	Elliott (new)
350	450	2300	Whse.
300	600	220	G.E.
200	450	2300	Burke
100	1160	440	G.E.
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.
7½	1880	220	Rel. (New)

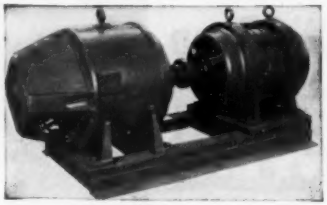
NEW DIRECT CURRENT

230 volt-dripproof

Qu.	HP	RPM	Mfg.	Frame
1	2/3	690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
3	7½	575/1725	G.E.	CD-77
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051
1	30	300/1800	G.E.	CD-1377

CRADLE TYPE DYNAMOMETER

225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.



M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
250	240	2300	G.E.
150	250	440	Whse.
100	275	2300	Whse.
50	250	440	G.E.
40	250	220/440	G.E.
30	125/250	2300/4000	G.E.
15	230	220/440	G.E.
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

NEW MAGNETIC SLIP RING CONTROL

1—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg	Brgs.
100	450/1350	Whse	Sl.
65	400/1200	Rel.	Sl.
50	300/900	G.E.	Sl.
50	500/1500	G.E.	Sl.
40	400/1200	Rel (TE)	Ball
35	400/1200	Ideal	Sl.
30	250/1000	Whse.	S.Sl.
30	500/1500	C-W (TE)	BB
30	500/1500	Rel	Ball
30	600	Whse.	Sl.
25	250/1000	G.E.	Sl.
25	500/1500	C-W	Ball
25	600/1350	Rel	Ball
25	690	Rel	Ball
20	250/1000	Whse.	Sl.
20	30/1200	Rel.	Ball
20	500/1500	G.E.	Sl.
15	250/1000	G.E.	Sl.
15	400/1600	Whse.	Sl.
15	575/1725	L.A.	Ball
15	650/1650	G.E.	Sl.
15	700/1350	Rel	Ball
10	300/1200	Whse.	Sl.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
10	1750	G.E. (TE)	BB
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	Sl.
7½	400/1600	Rel	Sl.
7½	400/1600	Whse.	Ball
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	Sl.
5	400/1200	C-W	Sl.
3	850/1700	Rel	Ball

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

3—500 H.P. 450 Lb. B&W Sectional Header Water Tube Boilers, Complete with Stokers, Superheaters, Boiler Feed Pumps, and all Miscellaneous Equipment.
2—250 H.P. Erie City 3 Drum Low Head Boilers, 1942, 200 Lb. Working Pressure, Peabody Burners, Brooks Control Equipment, Pratt-Daniel Stack on each Boiler Pumps, Heater, and Piping.
2—400 H.P. 225 Lb. Bigelow Water Tube Boilers, Oil Firing Equipment. Built 1941.
1—600 H.P. B&W Sect. Header Boiler, 200#.
2—250 H.P. B&W Boiler, Sect. Hdr. 200#, 1931.
1—250 H.P. B&W Boiler, Sect. Hdr., 225#, 1938.
1—500 H.P. Cleaver Brooks Package Boiler, 150 Lbs. #6 Oil, 1947.
A Number of Self Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.
Combustion Engrg., Spreader Stoker complete with fan & Hagan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.
1—6 Cylinder Enterprise Diesel, 800 H.P. direct connected to 1000 K.V.A., 3 ph., 60 cyl., 2400 V. Elliot Generator complete with all aux. Unit built 1948, 1400 hrs. use only.

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PUMPS—COMPRESSORS—BLOWERS

1—2000 GPM 350' Pump with 240 HP Turb.
1—750 GPM 231' Pump with 75 HP 3 ph. motor
2—675 GPM 428' Pumps with 125 HP Turb.
1—280 GPM 556' Pump with 50 HP 3 ph. motor
1—200 GPM 556' Pump with 50 HP Turb.
1—1100 GPM 220' Al.-Ch. Cent. Pump
4—2000-5000 GPM 32'-85', 10" & 12" Pumps
1—1000 GPM 280' all-bronze Cent. Pump
4—Kinney unused 6" Rotary Pumps
3—Blackmer 6" Rotary Pumps 500 GPM
5—750 & 1000 GPM Knowles Steam Pumps
1—8" x 10" & 1—7" x 10" Triplex Pumps
1—3" x 8" Galland Hydraulic Triplex Pump
1—6" x 10" Gardner Duplex Pump 300 GPM
1—12" x 14" Duplex Air Compressor 850 CFM
1—12" x 10" I-R Air Compressor 355 CFM
2—12" x 9" Werth. Comp. 375 CFM, Vac. & Press.
1—4-stage Norwalk Compressor 28 CFM 5000 PSI
1—Sturt. 60 H.P. Tur.-Blower 7000 CFM 20 oz.
1—GE 2-stage Turbo Blower 3000 CFM 16 PSI
1—Spencer 30 H.P. Tur. Blower 4000 CFM 16 oz.
1—60 H.P. DC 230 v. 1150 RPM comp. C-W Motor
1—50 H.P. DC 230 v. 1750 RPM ball.-bear Motor
10—Nash Vacuum Pumps and Vac.-Heating Units
250—Rebuilt Motors 1—200 H.P.
72—Exhaust Blowers, Fans, Unit Heaters

HUNDREDS OF OTHER ITEMS—ALL SIZES—ALL MAKES

SUPERIOR EQUIPMENT CO.

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DIESEL ENGINES

1800 HP Fairbanks-Morse, Model 38D 8-1/8, 8-1/8" x 10", 800 RPM, 10 Cylinder, air start, solid injection, complete with auxiliaries. *Excellent condition.*

480 HP Buckeye Diesel engine, 8 Cylinder, Model 80, 600 RPM, late type. *Rebuilt.*

Other sizes in stock

ALJON ELECTRIC DIESEL CO.

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BOILERS — TURBINES DIESEL SETS

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Air Compressors and Refrigeration Boilers 50-2000 HP; Turbo Gen. 100-5000 KW St. Eng. Gen. 75-1000 HP—Write for our Free New List of High Grade Used Equipment.

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Phone: Lincoln 4007

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500 KW GE SYNCHRONOUS CONVERTERS HCC6 (2)

220/280 V. DC Booster Type 1200 RPM Six Ph. Ped. Bear. Manual Control, Trans. to suit.

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510 LaSalle St. St. Louis 4, Mo.

UNUSED CENTRIFUGAL PUMPS

3 Goulds 2" Fig. 3760 centrifugal pumps, 200 GPM at 70 ft. head at 1750 RPM. Bases and couplings for direct motor drive included. (Pumps in storage Jersey City.)

STOREY PUMP and EQUIPMENT COMPANY
510 Harbour Commission Bldg., Toronto 1, Canada

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—15630 KVA G.E. Cond. 60 cy. 13200 V. 275-lb.
1—10000 KVA G.E. Cond. 25 cy. 6600 V. 200-lb.
1— 6250 KVA Allis Cond. 60 cy. 4000 V. 175-200 lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 385-lb.
1— 4375 KVA G.E. Cond. 60 cy. 2300 V. 200-lb.
1— 3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. SP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200 lb. Steel Valve Chest
2— 2250 KVA G.E. Cond. 60 cy. 240-480 lb.
1— 1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1— 1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1— 1563 KVA G.E. Extr. Cond. 60 cy. 2300 V. 200-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 938 KVA G.E. Extr. Cond. 30 cy. 240 V. 200-lb.
1— 938 KVA West. Extr. Cond. 60 cy. 2300/4160 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. SP

DIESEL ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1—1000 HP Superior 2300 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
1— 650 HP Amer. Loco. 440 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—675 KVA Chuse Corliss 2300 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES — 60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/285	13800	300
1	1500	G.E.	600	4150	600
6	1000	G.E.	600	13200	900 Auto.

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4600	900
1	1500	West.	2300	900

COMPLETE DIESEL PLANT

2—1250 KVA General Electric, 3/60/2300 V. 720 RPM generators coupled to General Motors 1700 HP Diesel engines. Complete with all auxiliaries. Still on foundation.

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
1	1000	Multi Anode	600	13800

MOTOR GENERATOR SETS — 60 CY.

QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	2000	G.E.	600	4000	450
1	1500	G.E.	600	4150	600
2	1000	West.	660	4150	900
1	500	West.	125	2300	720
1	150	West.	275	440	900
1	75	West.	125	440	1200

SYNCHRONOUS MOTORS — 60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
2	700	West.	2300	200
1	600	G.E.	2300	1800
1	600	G.E.	440	360
1	300	G.E.	2300	600
1	300	West.	2300	900
1	250	Cr. Wh.	440	300
1	115	West.	440	1200

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	5000	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	3000	G.E.	60/25	300
1	2500	G.E.	25/62½	750
1	2450	G.E.	62½/25	750
1	1700	West.	60/24	720
1	1250	G.E.	25/60	300

TRANSFORMERS — 60 CY.

3—	3333 KVA West.	132000—7620/13200 Y
3—	1000 KVA West.	66000—22000/2400/4000 Y
3—	75 KVA A.C.	66000/24000—7200/12470 Y
1—	2500 KVA G.E.	59/73 KV—5 taps, 3 ph.
4—	2500 KVA West.	44000—11000
3—	1500 KVA Wag.	44000—6900 NEW
4—	1000 KVA West.	44000—11000
3—	200 KVA Mol.	44000/22000—440/220
3—	100 KVA Wag.	44000—7200
3—	100 KVA G.E.	44000—2300
3—	75 KVA West.	44000—7200/12470 Y
3—	8333 KVA West.	43800—13900
3—	100 KVA Wag.	36000—11000, 3 ph.
1—18750 KVA A.B.B.		34840—11000, 3 ph.
6—	1500 KVA Pitts.	33000—2400
3—	200 KVA West.	33000—2400
3—	167 KVA G.E.	33000—2300/4000 Y
6—	150 KVA G.E.	34500—2300/4000
4—	150 KVA G.E.	33000—7200/12470 Y
3—	100 KVA A.C.	33000—7200/12470 Y
3—	75 KVA Wag.	33000—7200/12470 Y
3—	50 KVA G.E.	33000—2300
4—	450 KVA A.C.	25410/44000—13280/23000
4—	750 KVA Wag.	19650/33000 Y—6800/11950
3—	200 KVA G.E.	11500—220/110
3—	200 KVA Mol.	11000—2300
3—	867 KVA Kuhl.	7200/12470 Y—2400
3—	100 KVA West.	7200/12470 Y—2400
4—	50 KVA G.E.	7200/12470 Y—2300
3—	150 KVA Wag.	63000—2300
4—	100 KVA G.E.	6900/11900—2400
3—	37½ KVA G.E.	6900/11900—2400
1—	100 KVA G.E.	2300—575, 3 ph.
3—	15 KVA Stand.	250/225—117
1—	37½ KVA G.E.	230/460—115/230

OIL CIRCUIT BREAKERS

1—	600 A. 73 KV G.E. FHKO-236-500	Outdoor
1—	400 A. 37 KV G.E. FHKO-136-350	Outdoor
1—	400 A. 15 KV G.E. FKO-37-40	Outdoor
4—	600 A. 15 KV G.E. FHKO-139-750	Outdoor
2—	600 A. 15 KV G.E. FHKO-136-1328BS	Outdoor
1—	1200 A 15 KV G.E. FKO-139-350	Outdoor
1—	600 A. 15 KV G.E. FKO-139-350	Outdoor

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Immediate Delivery in All Types of

BOILERS

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We own and offer the following types of equipment now located at our warehouse:

B&W Boilers—300 and 500 H.P., 200 lbs.
Erie City Economics—125, 170, and 200 H.P.
Fire Box Boilers—165 H.P.
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2 New Frederick Stokers—2500 lbs. of coal/hr.

BOILER & EQUIPMENT CO.
743 Bedford Ave. Brooklyn 5, N. Y.
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FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

COMPLETE MODERN BOILER PLANT

2—HEINE 518 H.P. BOILERS

Built for 250# W. P. and arranged for pulverized fuel and oil firing.

Individual setting with Bigelow Liptak air cooled furnaces: double wall type.

Each Boiler fitted with 2 E. L. Wooley combination burners for pulverized fuel or Bunker C oil.

2—Raymond #55 Unit Coal Pulverizers, direct motor driven.

1—#90 Clarage Fan, motor driven.

1—Hays Combustion Control Panel with separate controls for each Boiler, consisting of: Recording Flow Meters, Pressure Recorders, Draft, Air Ratio, Damper Controls and Indicators.

also

Wheelco Alarm and Flame Control System, CO_2 Recorder, Copes Feed Water Regulator.

Oil Pumps and Heaters: Coal Hoppers with Syntron Vibrators and many other features to make the operation and control as automatic as possible.

This equipment installed in 1942, operated for approximately six years, set up in Woonsocket, R. I., as operated, and is in perfect condition.

Boilers are Massachusetts Standard and subject to most careful inspection.

YOUR INQUIRIES ARE SOLICITED

CONSOLIDATED PRODUCTS COMPANY, Inc.
443 CLINTON ST., WOONSOCKET, R.I. Phones: Woonsocket 5700-5701

PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

SQUIRREL CAGE, OPEN
3 Phase Motors

HP	RPM	VOLTS	DESCRIPTION
10	720	440	A-C
10	900	220	A-C
10	1200	220	A-C
10	1800	220	Westinghouse
10	3600	220	R. & M.
15	720	220/440	A-C
15	900	220	Howell
15	1200	220	Imperial
15	1800	220/440	G.E.
15	3600	220	G.E.
20	600	220	G.E.
20	900	440	A-C
20	1200	440	A-C
20	1800	220/440	G.E.
20	3600	440	A-C
25	600	440	G.E.
25	720	220	Westinghouse
25	900	440	G.E.
25	1200	220	Century
25	3600	220/440	L-A
30	514	440	Stanley
30	720	220	G.E.
30	900	220	A-C
30	1800	220/440	L-A
35	600	440	G.E.
40	720	440	G.E.
40	900	440	G.E.
50	720	2200	Westinghouse
60	1800	2200	G.E.
60	3600	2200	G.E.
75	1200	220/440	G.E.
83	3600	2300	G.E.
100	720	440	Westinghouse
100	1800	2300	Westinghouse
115	1200	440	G.E.
125	1200	330	G.E.
125	1800	2200	A-C
125	3600	220/440	A-C
150	1800	440	Howell
225	514	440	G.E.
250	600	2300	Triumph
300	900	440	G.E.
350	3600	2200	Westinghouse
750	900	6600	Westinghouse

* New Motors

SPECIALS

NEW DIESEL

Murphy ME650—165 HP, 1200 RPM 6 cylinder, 5¾ bore, 6½ stroke, complete. Will furnish engine only or as AC or DC Engine-Generator Set.

RECTIFIERS

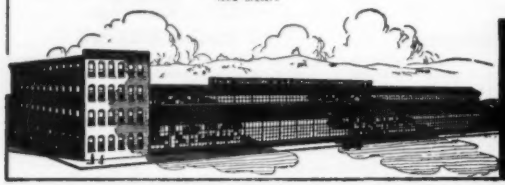
General Electric Copper Oxide with output 500 amp., 6 volts, D.C. and designed to operate on 440 volts, 60 cycle A.C. power. Units may be operated in multiple.

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
1	115	G. E.	1½	1800	220/440
1.15	115	Watts	2	1800	220
5	230	Westgh.	7½	1200	440
7½	125	Westgh.	10	1200	220
10	250	Westgh.	15	1800	220/440
12½	230	Westgh.	18½	1800	220
20	115	G.E.-Al. Ch.	30	900	220
22	125	Al. Ch.	33½	900	220
47½	125	Al. Ch.	100	1200	2300
50	125	C.-W.	85	1800	440
50	250	Al.Ch.-Westgh.	75	1200	220
75	125	G.E.	115	1200	410
100	250	Westgh.	147	1200	4300
200	250	G.E.-Westgh.	300	1200	440
300	250	G.E.	450	1200	2300
500	250	Westgh.-G.E.	600	1200	220/440
750	500	Westgh.	1070	900	13200
800	400/600	Westgh.	1280	1200	2300

ALTERNATING CURRENT GENERATORS

KVA	RPM	VOLTS	DESCRIPTION
12½	1800	440	Electric-Specialty-BB
18.75	1200	120/240	G.E.-1 ph.
20	1800	2300	Fairbanks-Morse
25	1200	120	Westgh.-1 ph.
31	1800	120/208	Westgh.
32*	1200	120/208	Westgh.-sgle. brg.
50	1200	240/480	Delco-sgle. brg.
50	1200	240/480	Delco-two bearing
75	1200	240/480	Delco-sgle. brg.
94	1200	600	Westgh.-sgle. brg.
125	600	2300	Allis-Chalmers-BB
125	1200	220	Westinghouse
200	184	440	G.E.-2 ped brgs.
200	200	240	G.E.-no shaft or brgs.
250	1800	4160	G.E.
610	600	12000	G.E.



GLOW ELECTRIC CO.

927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

M.G. SETS & CONVERTERS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	2300
500	West. Rotary	1200	250	2300
400	West.	720	550	2300
300	GE	1200	250	2300
300	GE Rotary	600	230	2300
300	West.	1200	250	2300
300 (2)	Al. Ch. Rotary	1200	250	2300
300	West.	1200	550	2300
150	GE	900	550	2300
150	West.	1200	250	2300
90	G.E.	1200	250	2300

DC HOIST MOTORS

HP	MAKE	WD.	SPD.	VOLTS
25	Cr.Wh. SM	Ser.	565	230
25 (2)	Cr.Wh. SW	Ser.	525	230
150	Cr.Wh. SM	Ser.	430	230

A.C. MOTORS

HP	MAKE	RPM	TYPE
400	GE	450	Sl.Rg.
300	GE	450	Sl.Rg.
150	GE	600	Syn.
100	West.	900	Syn.
100	West.	1200	Sq.Cg.
100 (2)	GE	1750	Sq.Cg.
100 (2)	GE	450	Sl.Rg.
75	West.	960	Sq.Cg.
60	West.	600	Sl.Rg.
50	GE	1750	Sq.Cg.
40	GE	900	Sl.Rg.
40	West.	900	Sq.Cg.
30	G.E.	900	Sq.Cg.
30	G.E.	1200	Sq.Cg.
20	West.	1200	Sq.Cg.
20 (New)	Al.Ch.H.T.	1060	Sq.Cg.

AIR COMPRESSORS

356 CFM Chg. Ph. 12"x10" NSB 100#.

MOORHEAD ELECTRICAL MACHINERY COMPANY

361 Noblestown Road (Est. 1919) Oakdale, Penna. Pittsburgh District

We Offer PRESSURE VESSELS FOR SHIPMENT NOW

USED CONDITION
CODE CONSTRUCTED BY
A. O. SMITH CORP.

8—10' ID dia. x 40' tangent to tangent x 3" shell. Heads 3½". Test pressure—900 psi. WP—600 psi. All-weld.

8—10' ID dia. x 40' tangent to tangent x 2½" shell. Heads 3". Test Pressure—750 psi. WP—500 psi. All-weld.

2—8' ID dia. x 40' tangent to tangent x 1½" shell. Heads—1¾". Test pressure 575 psi. WP—380 psi. All-weld.

8—8' ID dia. x 40' tangent to tangent x 2" shell. Heads 2¼". Test Pressure 750 psi. WP—500 psi. All-weld.

All vessels located near Chicago, Illinois, and offered subject to prior sale.

Write—Wire or Phone
Howard Kinslow

Kinslow Power & Equipment, Inc.

817 So. Boulder Tulsa 14, Okla.
Phone 5-5914

DIESEL and GASOLINE ENGINES and GENERATOR SETS

1 to 2000 K.W.

Transformers, Electrical Equipment
Sales, Purchases & Rentals
Nordberg Distributors

MIDWEST UTILITIES POWER EQUIPMENT CORP.

1270 Augusta Blvd., Chicago, Illinois
EVergiade 4-4511

550' TV TOWER; 8-Bay Antenna; Complete
125 HP 125# Erie Boiler with oil burner
800 Amp. GE Oil Switch 3/60/440 Volts
167' Clear Span Steel Hanger Building
250 HP Ideal Induction Motor 1200 RPM
150 & 100 HP—720 & 500 RPM Slip Rgs.
250 KW Gen. D/C Chuse N.R. Cort. Eng.
H. & P., 6719 Etzel, St. Louis 14, Mo.

300 KVA STEAM TURBINE

GE Curtiss #27056—200# 4 Stage—Surface Condenser 3/60/2300—3600 RPM.

VERY LOW PRICE

S. M. DAVIS
510 LASALLE ST., ST. LOUIS 4, MO.

SELLING FOR CUSTOMERS

2—100 KVA, 1 phase 60 cycle 2400 to 240/480 Pyranol trans.
1—50 1—100 & 1—150 KW M.G. Set 220/440 AC to 250 DC.
1—375 KVA Westinghouse noncond. turbine set.
1—37½ KVA 240/480 Diesel set.
What do you need—What have you to sell—Make use of our nation-wide service when buying or selling equipment.

H. BLANE JOHNSON & ASSOCIATES
53 W. Jackson Blvd., Chicago 4, Ill.

BOILER

261 H.P. Farrar & Trefts 1943—125#, series 500 with Detroit stoker.

MALLORY MACHINERY CO.
525 W. Conway St., Balto. 30, Md.

This Seal JLHP *...tells you what you buy is* **GOOD EQUIPMENT!**

GUARANTEED GOOD BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF

HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	Whse.	Hiperail	3	66000/33000 pri., 240/480 sec. w/Taps
1	1500	GE	Pyranol	3	4150x2200V
1	500	Kuhl.	OISC	1	4600x2300V
1	300	Pitts.	ODSC	1	7800x440V
1	200	GE	HT	3	2300x250
1	200	Whse.	Auto	3/3	4150x2300
1	200	Pitts	OISC	1	4800x110/220
1	200	GE	Auto	3/3	4150x2400
1	100	Pitts.		1	2750x110/220
3	100	Wagner	RCKV	1	240x120/120
6	50	GE	H	1	13,750x125/216Y
2	37½	A. Ch.	AD	1	450x120
2	25	G.E.	H	1	11,500x230/460

SPECIAL—WELDING MOTOR GENERATOR SET

1—176 KVA Whse. Welding Gen. Set, 1 Ph. 20V, 800 Amp 57% PF with Slip Ring Motor & Exciter

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED DC	AC
1	1000	GE	514 600	2300/4150 Syn.
1	300	GE	1200 250	2300 Syn.
1	200	Whse.	900 250	220/440 Syn.
2	150	GE	1200 125/ 250	2300 Syn.
1	150	Whse.	600 125	4150 Syn.
1	125	CW	1200 125	2300 SC
1	100	CW	1200 125	220/440 SC
1	100	El. Mach.	1200 125	4150 Syn.
1	94	GE	1200 60	440 SC
3	94	GE	1200 60	4150 Syn.
1	75	Cr. Wh.	1200 250	4150/2200 syn.
2	40	El. Mach.	1750 125	440 SC

SYNCHRONOUS

300 HP El. Mach. 720 RPM 2300 V T.E.F. C. outdoor Service

200/100 HP Whse. 720/360 RPM 4150 V.

SLIP RING

1	2500	GE	MT	6600	257
1	250	Whse.	CW	440	600
1	200	GE	MT	2300	1800
1	200	Whse.	CW	440	600
1	200	GE	MT	440	600
1	100	GE	TM	440	400
1	75	GE	MT	220	1200 Vert
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200

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J. L. HEMPHILL & CO.
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PHONE NEW JERSEY—UNION 3-2600

BOILERS

10 to 1000 H.P.
NEW-USED
RECONDITIONED
Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

BOILERS—TURBINES

1—Erie City—3 drum, bent tube water tube boilers, 1940, rated 29,000# steam per hour, each, can produce 42,000# steam per hour each, with water walls. Rated 500 HP each at 250# steam pressure, complete with oil burners and trim.

1—Combustion Engineering, 3 drum, bent tube, low head, water tube boiler, 1943. Rated 20,000# steam per hour, 400 HP at 185# steam pressure, complete with stoker and controls, valves etc.

1—Unused 140,000# per hour Combustion Engineering Steam Generator, V U Type, 450# steam pressure.

Also:

2—750 HP B & W straight tube boilers, 225# to be released soon.
3—600 HP B & W straight tube boilers, 200# to be released soon.
Various package units from 25 HP to 500 HP various pressures.

We also carry power and distribution transformers, switch gear, including potential and current transformers, circuit breakers etc.; also steam turbines, all sizes and pressures.

WE BUY ENTIRE CENTRAL AND POWER STATIONS

HOWE BROTHERS

342 MADISON AVENUE MUrray Hill 2-8562 **NEW YORK 17, N. Y.**

TRANSFORMERS—60 cycle

2—1250 KVA, A. Ch., 4800/460—3 ϕ
2—1250 KVA, A. Ch., 4160/460—3 ϕ
1—2500 KVA, A. Ch., 4800/460—3 ϕ
1—2500 KVA, A. Ch., 4160/460—3 ϕ
1— 667 KVA, A. Ch., 4160/460—3 ϕ
3—1250 KVA, G. E., 13200/440—1 ϕ
3—1250 KVA, G. E., 13800/440—1 ϕ
3—1250 KVA, G. E., 7200/12470Y/440 1 ϕ
2— 750 KVA, Gen. E., 11000/480; 3 ϕ, 25 cycle
1— 500 KVA, Scott Bank 2200, 3ϕ—pri. 220/440 2 ϕ
1— 100 KVA, Wagner, 480/120/240—1 ϕ
1— 325 KVA, Furn. 2300/4600/125—1 ϕ
1— 100 KVA, A. Ch., Furn. 440/110/80/60—1 ϕ
3— 75 KVA, A. Ch., 33000/2300/4160—1 ϕ WH. SW. GR.
2—75 KVA Gen. Elec. type H, OISC, 4160/4600, 230/460, 1 Phase
3—50 KVA Kuhlman OISC, 11,000 V. Pri., 120/240/480 V. Sec. 1 Ph.
6—25 KVA, Kuhlman OISC, 2300/4600 Pri., 115/230 Sec. 1 Ph.

M.G. SETS

1000 KW, A. Ch. 250 V. DC, 1400 HP, 3 ϕ, 25 cycle. Or will consider changing motor for 60 cycle. Complete with switchgear.
200 KW, A. Ch., 125 v. D.C.; Mtr. 300 HP 3/30
40 KW—1000 amp., 40 V—DC mtr, 7 SHP 3/60
60 KW—1500 amp., 40 V—DC, mtr. 100 HP 3/60
100 KW, 125 volt D.C. mtr. 150 HP, 3/60
30 KW, 125 V D.C. mtr. 50 HP 3/60

FREQUENCY CHANGERS:

KVA—465 25/60 cy. or 60/25—3 ϕ RPM 300 Motor 650 HP, 3 ϕ, 300 RPM with sw. gear
1—200 KVA Gen. Elec. 25 cyle to 62½ cycle, 750 RPM, Motor 300 HP, 25 cycle, complete with panels
1—120 KW, 25/62½ cycle, 3 ϕ 720 RPM. Motor 200 HP 3/25/720 RPM
3— 20 KVA, G.E., 60/180 cycles 3 ϕ
3— 30 KVA, G.E., 60/180 cycle 3 ϕ
3— 25 KVA, G.E. 60/120 cycle 3 ϕ
1— 15 KVA, G.E., 60/120 cycle 3 ϕ

SQUIRREL CAGE MOTORS
3 phase, 60 cycle

HP	Make	Type	RPM	Volts
150	G.E.	IK14	1200	2300
100	A. Ch.	S.C.	690	440/550
100	G.E.	IK17	400	220/440/2300
150	G.E.	IK17	514	220/440/2300
75	G.E.	IM S R	600	220/440/2300
75	G.E.	IK	400	220/440/2300
75	West.	CW S R	1200	2300/440/220
50	A. Ch.	ANY SR	900	220/440
40	Star	BB S R	900	220/440
40	G.E.	IK	900	220/440
100	G.E.	IK	1800	220/440
200	G.E.	KT 25 cyc.	750	220/440
200	West.	CS 25 cyc.	750	220/440
150	C. Wh.	25 cycle	480	2300/440/220

1—G.E. 3 pole switchgear 3700 volt 400 amp
1—400 amp. 3 pole 15000 volt breaker G.E FK132A

VOLLAND ELECTRIC EQUIPMENT CO., INC.

Subsidiary Co.—Buffalo Transformer Co.

1500 NIAGARA ST. **BUFFALO 13, NEW YORK**

MOTORS • GENERATORS • TRANSFORMERS

7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 3/60/220/440/1800 X-Proof.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries. New Transformers built to your specifications.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

SINCE 1912 CINCINNATI 27, OHIO

John H. Benson Roy L. Wilimzig

MOTORS!! PUMPS!! TRANSFORMERS!!

4—1000 KVA Amer. Brown Bovari 33000 PRI 2400/4160Y Sec. volts transformers

1—200 HP, 600 RPM, GE. Slipring IM. Frame 17. 3/60/220/440

1—150 HP, 514 RPM. Westinghouse Slipring. Type HF. 3/60/220/440

3—75 HP, 900 RPM. Westinghouse Squirrel Cage. Type CS. Frame 752C, 3/60/220/440

1—1000 KVA—AC Generator Westinghouse. 3/60/2300 V., 720 RPM

1—1000 KVA Synchronous Condenser. 3/60/2300/4000. 600 RPM

2—24x24 Dayton Dowd CS24. 16,500 GPM. 18.5/35 FT. HD., 360/450 RPM

Phone, Write or Wire!

BENSON-WILIMZIG, INC.

formerly C & S Machinery Co.

1708 N. 8th St. St. Louis, Mo.

GA-4290

SURFACE CONDENSER FOR SALE

One, 1950 sq. ft. two pass Surface Condenser designed for 16,000 lbs. of steam per hour with 2210 GMP of cooling water, steel shell; 54" steam inlet; Muntz metal tubes and tube sheets; cast iron water boxes; dimensions 49" x 16' 9". Condition—Good. Now in service, will be available about March 1, 1952. Price on request.

Address communications to the Director of Purchases

AMERICAN ENKA CORP.

ENKA (near Asheville), N. C.

TURBO-GENERATORS

2000 K.W., 3 ph., 60 cy., 150 lbs G.E.
1000 K.W., 3 ph., 60 cy., 250 lbs G.E.
750 K.W., 3 ph., 60 cy., 200 lbs extract. G.E.
500 K.W., 3 ph., 60 cy., 150 lbs G.E.
150 K.W., 250 v. new Westgh., D.C.

DIESEL UNITS

62½ KVA., 3-60-220-440 v., Caterpillar
37½ KVA., 3-60-220 v., Ready Power
100 K.W., 250 v., D.C. Superior Delco

UNUSED PUMPS & MOTORS

Union Steam Co., pumps all 250 ft. head with new Louis Allis motors, 1750 rpm.
1—400 GPM, 50 HP motor
1—500 GPM, 75 HP motor
1—800 GPM, 100 HP motor

TRANSFORMERS

1—600 KVA., 3 ph., 13800 x 575
1—500 KVA., 3 ph., 11500 x 460
2—500 KVA., 13800 x 2300
7—100 KVA., Gen. Elec. 11000 x 2200 v.
3—100 KVA., Maloney 11400 x 2200 v.
4— 50 KVA., Gen. Elec. 11000 x 2300 v.
2— 50 KVA., Westgh. 13800 x 230—460 v.
100—Transformers late type pocket bushings 12000-11500 x 120-240

3 PH., MOTORS

425 HP., Gen. Elec. MT414Y, 392 rpm., Slip rg.
300 HP., Gen. Elec. 257 rpm., syn.
200 HP., Gen. Elec. IM.—585 rpm., Slip rg.
200 HP., Westgh. CW., 1750 rpm., Slip rg.
200 HP., Gen. Elec. IM., 435 rpm., Slip rg.
200 HP., Gen. Elec. KT550, 1150 rpm., Sq. cage
150 HP., Gen. Elec. IM., 1800 rpm., Slip rg.
150 HP., Gen. Elec. IM., 514 rpm., Slip rg.
100 HP., Gen. Elec. IM—570 rpm., Slip rg.
100 HP., Gen. Elec. IM—585 rpm.
100 HP., Westgh., 900 rpm., Syn
100 HP., Gen. Elec. KT543, 1800 rpm., Sq. cage
100 HP., Elec. Mchy. 300 rpm., syn.

SUB STATION

2—400 amp., 3 pole 15000 volts FO24 Westgh. electrically operated breakers disconnects etc.

We carry a large stock of all kinds of direct current motors etc. What have you for sale? What do you need?

KEYSTONE POWER PLANT EQUIPMENT CO.

8403 Hegerman St. Phila. 36, Penna.

POWER EQUIPMENT—READY TO SHIP

IMMEDIATE DELIVERY
AIR COMPRESSOR

1000 cfm Chicago Pneumatic 100# pressure 2300 or 440 v, A.C. syn. motor. Complete with starter and all accessories.

A.C. MOTORS
220/440 v. 3 ph. 60 cy.

HP	Make	RPM	Type
1000	Elec. Mach.	1200	syn.
500 New	Allis-Chal.	1750	drip proof
375	Westg.	580	2300 v.
250	G.E.	515	tefc. bb.
250	Burke	720	syn.
250	G.E.	1200	I-E
250	G.E.	1360	2200 v.
225 syn.	Elec. Mach.	1800	2300 v.
225	Elec. Mach.	1800	syn.
200	Westg.	291	CS
200	G.E.	435	tefc.
200	G.E.	860	2300 v.
200 (4)	Wagner	1750	BP-3
200	G.E.	1800	(2200 v.) syn.

SLIP RING MOTORS
3 Phase—60 Cycle

HP	Make	RPM	Volts
450	Allis-Chal.	293	2200
400	West.	438	2200
300	Cr.-Wh.	290	2200
200	West.	500	220/440
200	West.	500	2200
150	G.E.	600	2200
150	West.	870	2200
150	West.	870	220/440
100	Triumph	580	550/440/220
75	G.E.	600	550/440/220

CLEANING MILL

1—Ranschoff Cleaning Mill 48" x 72", side loading side unloading, star return, with sand handling conveyor complete with tank, pump and motors.

SPECIAL BARGAINS
Diesel Engine Generator Sets

2—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 250 HP Model GSD-8, 5½x7, 8 cyl. Superior DIESEL Engine, elec. start with engine panels.
2—100 KW same as above with 220 or 440 v. NEW A.C. Generators.
10—37½ kva. 3 ph 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A.C. Generators with dir. con. exciters driven by 70 HP, 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.
1—90 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 300 rpm DIESEL.
4—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 58 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.
5—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels.

VARIABLE SPEED MOTORS
230 Volt DC

HP	RPM	Make	Type
100	500/1000	West.	SK-190
100	625/1250	West.	—
50	750/1500	West.	SK-150
50	750/1000	West.	SK-141L
50	300/1200	Cr.-Wh.	CMC
40	385/1200	Elec. Mchy.	—
40	750/1500	West.	SK-140
40	575/1150	Al.-Chal.	E-145
30	725/1450	West.	SK-130
25	500/1500	West.	SK-110L
25	300/1200	G.E.	CD-123

ELECTRIC MACHINERY FREQUENCY CHANGER SET

600 KW Motor Generator Set consisting of 1000 KW, syn. motor 440/3/60 1200 rpm, and 1—750 KVA 440 V. 3 Ph. 180 cycles 1200 rpm, 80% P.F., complete with exciter and automatic control switch gear. EXCELLENT CONDITION.

FOUNDRY HOIST

3 Ton Robbins & Myers, 2 Motor, 220 Volt, 3 Phase, 60 Cycle.

MOTOR GENERATOR SETS

150 KW, Crocker Wheeler, 250 V. DC, 1750 RPM, 2300 or 220/440 Volt Ind.
100 KW, Hobart, 250 Volt, 2200 Volt, 3 Phase, 60 Cycle, 1750 RPM Ind.
50 KW, West., 250 Volt DC, 1150 RPM, 220/440 Volt AC.

NEW ENGINES

75 HP, P&H, full Diesel, Model 287C, 1400 RPM, heavy duty, 3 Cylinder.
158 HP, P&H, 6 Cylinder, full Diesel, Model 687C, 1400 RPM, heavy duty.

230 Volt DC Motors

HP	Make	Type	RPM
600	Cr.-Wh.	CCM	300/330
400	Cr.-Wh.	CCD	200
400	West.	—	300
160	Cr.-Wh.	CMC	1200
100	West.	SK-190	500
100	West.	SK-142L	1700
60	West.	SK-153	850
60	West.	SK-123L	1750

250 Volt DC Generators

KW	Make	Type	RPM
500	Cr.-Wh.	CCM	375
375	West.	—	400
150	Burke	H-70	900
150	Cr.-Wh.	CMC	1450
100	West.	SK-190	720
100	Al.-Chal.	—	275
100	Delco	120/240	1200

TRANSFORMERS—1 ph. 60 cy.

No.	Kva	Make	Primary	Sec.
3	200	Pgh.	22000	2300
2	150	Pgh.	4600	115/230
1	110	Pgh.	4600	115/230
6	100	Pgh.	4600	115/230
2	100	Allis-Chal.	4800	120/240
2	100	G.E.	4800	120/240
1	75	Pgh.	4600	115/230

PUMPS

2777 GPM Fair. Morse Cent. 225' hd. 8" dis. 10" suc. 300 HP. A.C. Syn. Motor.
2083 GPM Fair. Morse Cent. 235' hd. 8" dis. 10" suc. 225 HP. A.C. Syn. Motor.
1000 GPM Ing. Rand 100# pres. Fire Pump with 100 HP 220/440 v. A.C. Motor.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

WATER TUBE
BOILERS

Union Iron Works Horizontal Straight Tube

2—259 H.P., single drum

2—350 H.P., two drum

First-class condition
Immediate delivery

JAMES T. CASTLE CO., INC.
534 FIRST AVE.
PITTSBURGH 19, PA.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Qu.	HP	Mfg.	Volts	Type	Fr.	Sp.
1	50	Woods	220/440	EFC	72	1200
1	100	West.	440	CS		690
16	100	West.	2200	CS	774C	865
1	125	G.E.	440	KT	547	1800
2	150	Al.-Chal.	2300	ARW		1750
1	200	**G.E.	2300	K	564	900

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	HP	Mfg.	Volts	Type	Fr.	Sp.
1	30	G.E.	220	MT	342	690
1	40	G.E.	220	MT	346	690
1	40	Al.-Chal.	440	B. Brg.		900
1	50	West.	220	CW		1175
1	75	G.E.	220	MT	456	870
1	100	G.E.	220		16	430
1	*250	C.W.	550	BW	68-CS	1800
1	*300	C.W.	550	BW	66-DS	1800
1	*500	C.W.	550	BW	80-BS	1800
1	500	G.E.	2300		17B	900
1	*600	C.W.	550	BW	80-CS	1800
1	600	West.	440			1800

SYNCHRONOUS MOTORS—3 Ph., 60 Cy.
With Direct Connected Exciters

Qu.	HP	Mfg.	Volts	Type	Fr.	Sp.
1	75	El. Mach.	220			1200
2	**125	El. Mach.	4800			900
15	***135	G.E.	4600	TS	963Z	1200
1	175	Burke	2200	F	40	720
1	*200	**El. Mach.	208			1200
1	*300	**El. Mach.	208			1200
1	*350	**El. Mach.	208			1200
1	*400	**El. Mach.	440			1200

DC MOTORS BALL BRG. MARINE TYPE

Qu.	HP	Mfg.	Volts	Type	Fr.	Sp.
1	*10	**West.	115	SK	53	1500
1	*12	**Nel.	115	Y	46Y	1500
2 Vert.	23	**Cent.	230	DN	375Y	1750
2 Winch	42.5	**G.E.	230	CDM	1830AE	525
3 Winch	50	**West.	230	CK	9	600
8	75	**C.W.	230	TEFC	52H	860
1	75	**Al.-Chal.	230	DEB-1		1150

DC GENERATORS BALL BRG. D.P.

Qu.	HP	Mfg.	Volts	Type	Fr.	Sp.
1	20 KW	C.W.	120	H	DH	1450
11	25 KW	West.	125	SK	103	1800
7	25 KW	El. Prod.	125			1800
1	30 KW	Burke 1-Brg.	120		WA2	52	1450
2	300 KW	G.E. 1-Brg.	345/260	CY	221	1200

AC GENERATORS 3/60/440/.8 P.F./1800

11	75 KVA	West.	1-Brg.
7	75 KVA	El. Prod.	1-Brg.
1	62.5 KVA	El. Prod.	2-Brg. 120—208V/900 RPM

DIESEL ENGINES—PUMPS
TURBINE GENERATORS—M-G SETS

4 New Hercules 135 HP Mod. DWXD
250 KVA Elliott Turbo Gen. 3/60/208V/1200 RPM
150 KW G.E. 3 Brg. Syn. 3/60/220V/1200/240 V/DC
2—100 KW Buckeye AC 3/60/220V/400 RPM
1—200 KW Buckeye AC 3/60/2200V/300 RPM
Worthington Fire Pump—1000 GPM w/100 HP G.E. KP 543 3/60/220V/1800 w/compensator

*NEW—**BALL BEARING—***SEP. EXCITER

ALBERT HELLER CO.
210 Snediker Ave. HYacinth 5-0800 Brooklyn 7, N. Y.

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260 H. P. DIESEL ENGINE

Liquidation Sale—Twin 6—71 General Motors model 12103. Heavy duty reduction gear to 900 R.P.M. With starting batteries and silencers. A standby unit used 4500 hours.

MARTIN J. HANSON TRUSTEE
1300 N. KOSTNER AVE. CHICAGO 51, ILL.

---

100 KW GENERATOR SET

BUCKEYE DIESEL 400 RPM 3/60/240 with V-Belted exciter, Switchgear, Voltage Regulator, Oil filter, Silencer, Water Pump. Engine overhauled.

Immediate delivery—Priced to Sell

ROBERT L. NEISWANDER
1007 S. Ocean Dr.
Hollywood, Fla.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

IMMEDIATE DELIVERY

1—50,000# hr. 4-Drum Stirling type, 250# Boiler (8,500 sq. ft. H.S.) Super heat. Condition excellent, ASME, any fuel, now oil fired.

1—80,000# hr. Steam Generator 350#, Very efficient, economizer, air heater, etc. Steel cased, excellent condition.

768 HP B&W Sterling Boiler, 200#, with new tubes & superheaters.

● We have many other boilers in sizes of 250 to 600 HP, 200 to 450# pressure. See our September Power ad.

Turbo-Generators, Condensing, 300 to 10,000 KW. Non-Condensing, 200 to 2500 KW. Frequency Changers

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators & Diesel-Generators See Our September Power Ad

Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. **NEW YORK 7, N. Y.**

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (3)	2200	G.E.	900
500	2200	G.E.	450
450	440/220	Whse.	514
350	2200/440	G.E.	450
300	2200	G.E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	2200/550	G.E.	450
250	550/440	G.E.	1200
270	440	G.E.	600
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (3)	1800
145	4000/2300	G.E.	1800
125	2200/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/400	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2200	El. Mchy.	Syn.	600
240	2200/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37500 v., G.E., Type FHKO-238 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal	AR	1800
200	2200	G.E.	K	3600
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
150	440	multi sp.	KT	1800/600
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KP	1800

A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 V., G.E.
3— 75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230 (2)	Whse.	SK	850
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—230 kw, 1200 rpm, 240 V., Whse., conn. to 350 hp, 2200 V., sq. cage.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 135 hp, 440/220 V., sq. cage.
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/400 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage.

TRANSFORMERS 60 CY.

2—500 kva, G.E., 4000—2300 V.
3—333 kva, G.E., 13,200—2300 V.
1—300 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
3—300 kva, Whse., 13200—440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, G.E., 13200—460/230 V.
3—200 kva, Whse., 2400—240/120 V.
3— 75 kva, Moloney, 4150—240 V.
1—150 kva, Whse., 2400—240/480 V. (Pyranol)
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/25 V.
1—150 kva, Whse., SK, 13200-125/215 v., 3 ph.
3— 75 kva, Whse., 2400—240/480 V.
6— 50 kva, G.E., 2400—120/240 V.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

2—6000 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# Extr.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 230# N.C.
2—1000 KW, 480 V., 180# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 500 KW, 2300 V., 165# Cond.
1— 300 KW, 2300 V., 150# Cond.

DIESEL GENERATORS

1—1000 KVA, 2400 V.
1— 700 KW, 480 V.
3— 540 KW, 480 V.
1— 437 KW, 480 V.
1— 200 KW, 480 V.

FIRE PUMP

1—New 1000 G.P. Turbine Driven

BOILERS

1—1,000 HP, 250#
2— 500 HP, 200#
1— 438 HP, 200#
2— 300 HP, 250#
2— 250 HP, 200#
4— 150 HP, 150# So. Mr.
1— 78" H.R.T., 200#

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

FOR SALE

ATRITA UNIT PULVERIZER

1—23 Relay 1949 Atrita Unit Pulverizer, with 60 H.P., 1800 RPM, 220/440 V. 60 cycle, totally enclosed motor, Rawson Coupling, also Riley Table Type Feeder with Reeves Variable Speed Drive. Has had very little use.

MORGAN CONSTRUCTION CO.
Worcester, Mass.

SPECIAL TRANSFORMERS — YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGES

ARROW TRANSFORMER CO., INC.

1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

FOR SALE AT DISCOUNT

1—New Iron Fireman Spreader Stoker with fans & controls. 1600 lbs./hr. cap. Never installed. Ready to ship.

STANDARD MILK COMPANY
AURORA, MISSOURI

EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

A A A IRON CO.
Canton & Hawkins Sts., Dallas 1, Texas

TRADE WITH BAUER

BUY - SELL - TRADE
your
COMPRESSOR
VACUUM PUMP
STEAM BOOSTER
L.W.BAUER
265 ESSEX AVE. NEWARK 2

DIESEL GENERATOR FOR SALE

180 H.P. FAIRBANKS-MORSE direct connected to 240-2300 volt alternator, 150 K.V.A., Direct connected exciter. In excellent condition with new Midwest Oil Filter and Voltage Regulator. Available immediately. $5100.00 f.o.b. Versailles, Missouri.

VERSAILLES ICE COMPANY, Versailles, Mo.

URGENTLY WANTED

2—300 HP 2300/3/60 sq cage 900 or 1200 RPM
250 HP 2300/3/60 sq cage 900 RPM
300 HP 2300/3/600 RPM Slip Ring
750 KVA 440/3/60 Steam Turbo Gen. Set, complete 150 pounds—condensing
200 HP 2300/3/60/3600 explosion proof
100 KW 550/3/60 Generator 900 RPM preferred
100 KW 550/3/60 Diesel Generator set

Please send your surplus lists—We have been selling Electric and Power Equipment—here—41 years—we frequently find outlets for machines that would be slow moving elsewhere.

FOR SALE

2—1250 KVA 2300/3/60—Gen Elec—Gen Motors Diesel Engin Gen sets complete

1—2300/3/60 complete steam Turbo Plant—including 1—800 KVA unit and one 300 KVA unit

1—300 HP 550/3/60/900 RPM Syn Motor

We can mention only a few items here—Send your enquiries—We have surprised many important customers by producing precious machines—for immediate shipment—when it was thought impossible—WE BELIEVE IN PRAYER.

SOUL CLINIC, INC.

815 8th Ave., Calgary, Alberta, Canada — Phones 25962, 22030

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—to help you sell what you no longer need.

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For Every Business Want
"Think SEARCHLIGHT FIRST"

MOTORS—M. G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	Cent.	NZ-806	2300	1200
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-859D	2300	1780
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	450
2	100	Whse.	CS-663C	440/220	1750
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	78	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765
1	75	Al.Ch.	AR	2200	1750
1	75	Al.Ch.	AR	2200	690

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
1	750	G.E.	80	2300	450
1	187	G.E.	80	220/440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550/2200	600
1	150	G.E.	80	550/2200	450
3	135	G.E.	80	4000/2200	1200
3	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900
2	100	Whse.	80	440/220	1800
1	100	Whse.	100	2200	1200
1	100	Ideal	80	220/440	900
2	100	G.E.	80	220/440	600
1	60	G.E.	80	220/440	1200
2	50	G.E.	80	2200	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	1200	C.W.	SR	2200	237
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2200	360
2	500	G.E.	I-16-M	2300	450
1**	400	Al.Ch.	ANY	2200	514
2	400	G.E.	MT-412	2200	450
1	300	G.E.	I-15-M	2200	1200
1	300	Al.Ch.	ANY	2200	514
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	585
1	150	G.E.	I-13-M	2200	1750
1***	125	Whse.	CW-870	2200	870
1	100	F.M.	H20C	440/220	900
1	75	G.E.	IM	440/220	695
1	75	Whse.	CW-7540	440/220	690
1	60	Whse.	CW	440/220	900
1	50	G.E.	MT-536	2200	1150
1	50	F.M.	SR	440/220	600
1	40	Al.Ch.	ANY	2200/440	435

** Mill type pedestal bearing *** 3-Bearing

In our stock you will find manual and magnetic primary and secondary controls 10 to 3000 lbs., which we can furnish complete for any requirements.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	525	4800/2400
1	2400(3-U)	Whse.	720	600	4800/2400
1	1000	G.E.	514	550	2300
2	500	C.W.	720	575	2300/440
1	500	C.W.	720	250/275	2300/440
1	250	Whse.	1200	125/250	2300
1	200	Whse.	1200	125/250	2300/440
1	200	Ridgway	900	275	2200
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Al.Ch.	1200	125/250	4000/2300
1	100	Delco	1200	125/250	440/220
1	100	C.W.	1200	125	440/220
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	4000/2300
1	75	Star	1200	230	440/220
1	75	Whse.	900	75	2200
1	75	Al.Ch.	900	250	2300
1	50	Burke	1750	250	440/220
1	35	Whse.	1750	250	440/220
1	25	Ideal	1750	125	220
1	20	Al.Ch.	1200	250	440/220
1	15	Al.Ch.	1200	250	440/220
1	9	Whse.	1200	125	440/220
1	5	Reliance	1750	250	440/220

TRANSFORMERS — Power

Qu	Make	KVA	Type	Phase	Voltage
1	G.E.	2760	DH	3	7300/6900-240/480
3	Whse.	500	S	1	13800/72420/6900-4160/2400
4	G.E.	333	H	1	13200/1100-2200
3	Packard	250	A	1	13200-2200
3	G.E.	150	H	1	19000/9500-550/2200
3	G.E.	100	H	1	33000-2300
3	Whse.	100	SS	1	12075/10955-230/460
3	Whse.	100	Auto	1	4160/2400-2400/1385
2	Wagner	50	HE	1	13200/11880-575/287
3	Al.Ch.	50	OISC	1	22000-220
2	Uptegraff	37½	HD	1	2300-115/230
2	Kuhlman	13	Dry	1	480-240
45(new)	Al.Ch.	3	OISC	1	2400-120/240

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Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-169-A	1150
1	200/250	El.Dy.	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	500/1200
1	200	Whse.	Mill	300/1200
1	180	G.E.	MPC	400
1*	150	C.W.	83-H	850
1***	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
1	100-125	Rel.	1095-F	300/1200
2	100	Rel.	1050-F	400/1200
1	90/160	G.E.	MPC	625/1125

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1½	3	1	1	10	6	6	12	5	2	2	1
2	3	1	1	12	7	6	8	6	4	4	1
3	2	1	1	9	8	3	3	3	2	2	
5	4	1	1	12	7	5	5	4	3	3	1
7½	4	1	1	12	7	5	6	7	3	3	
10	4	1	1	12	7	5	7	7	3	2	
15	1			10	5	3	3				
20	2			6	6	3	1				
25	1			4	3	1	1				
30				2							
40				1							
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1500(5)	Pitts.	33000	2300
1250(3)	GE	11000	2200
1000(4)	Am.	33000	2300/4000Y
1000(3)	GE	66000	7200/7025
1000(3)	Penn.	13800	230/460
1000	West.	2200	220
833(2)	GE	13800	460
833(3)	West.	2300	575
750	GE	2300	2/3 ph. 2300
750(4)	GE	2200	244/488
667(3)	GE	13200	2300/4000
667(1)	Al. Ch.	13200	480
667(3)	Davis	6600	2300/4000
500(1)	Mol.	13800	230/115
500(2)	GE	11000	2300
500		4600	460
500	GE	34500	230/460
480(11)	GE	22000	190
480(3)	West.	22000	190
450	Uptegraff	11000	460
450(1)	Uptegraff	11000	230
400(2)		2300	3 ph. 230
400(3)	Wag.	2300	440/220
400(3)	GE	2200	244/488
333(1)	GE	22000	2200
333(3)	GE	22000	2200
333(1)	GE	22000	2300
333(2)	GE	11500	115/230
333(3)	GE	11000	2200
300(3)	West.	14520	550/230
300(1)	Pitts.	6600	110
300(3)	Pitts.	2300	115/230
300(2)	GE	2300	115/230/440
250(1)	GE	2400	240/480
250(2)		2300	115/230
250(3)	GE	2400	240/480
250(1)	Wag.	2200	440
250	West.	463	
200(3)	West.	26400	267
200	GE	15000	230
200(4)	West.	13800	278
200(3)	West.	13200	2300
200(4)	Pitts.	4150	460
200(2)	Pitts.	12000	115/230
200(3)	Wag.	2300	230/115
200(3)	GE	2400	120/240
200	GE	495	120/240
200	GE	2200	122/244
200	West.	2300	600
200	GE	11500	460
200	West.	3984	115/230
200	GE	6900	2400
150(1)	West.	6900	120/208
150(3)	West.	14400	600
150(3)	West.	14400	575/230
150(4)	GE	12000	115/230
150(1)	West.	2400	480
150(4)	Packard	4600	230/115
150	GE	2400	240/480
150(3)	GE	2200	110/220
150(3)	Pitts.	7200	115/230
150(3)	GE	4150	120/240
125	West.	440	440
125	West.	440	440
100(4)	Penn.	600	120/240
100(3)	GE	14490	2400/4800
100(2)	Al. Ch.	4600	230/115
100(2)	West.	13200	220
100(4)	Al. Ch.	2400	480
100(2)	Pitts.	2300	230/460
100(1)	West.	2300	230/115
100(4)	Al. Ch.	2300	230/115
100(1)	GE	2300	230/460
100(7)	GE	1980	220/440
100(3)	GE	1100	220/440
100(3)	Pitts.	4600	230/115
100(3)	GE	460	115/230
100	GE	11500	230/460
100	GE	11000	2300
100	GE	2400	120/240
75(3)	GE	2300	115/230
75(1)	Wag.	2400	120/240
75(1)	Kuhlman	4600	115/230
75(1)	West.	6900	115/230

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America needs your daily pound of scrap

IF every man, woman and child in America provided one pound of scrap each day, they would supply just about enough to produce the 105 million tons or more of new steel that the industry hopes to make in 1952.

Like yeast in breadmaking, scrap is essential to steelmaking. Scrap speeds up the process because scrap is already-refined steel. Every ton of scrap used replaces one ton of pig iron. Thus scrap also saves raw materials, because each ton of pig iron represents two tons of iron ore, one ton of coal and half a ton of limestone.

The continuing co-operation of every reader of this page is urgently requested to overcome a scrap shortage daily growing more critical. Turn in--by selling your scrap to regular scrap-gathering channels--any and all broken, worn-out or obsolete things made of iron and steel--machines, tools, pipe, boilers, structural parts and other "junk" you'll probably never use again.

Do your part in the campaign to help meet America's need for more steel. Enlist now for the duration. Remember that the scrap you furnish may help you get more steel.

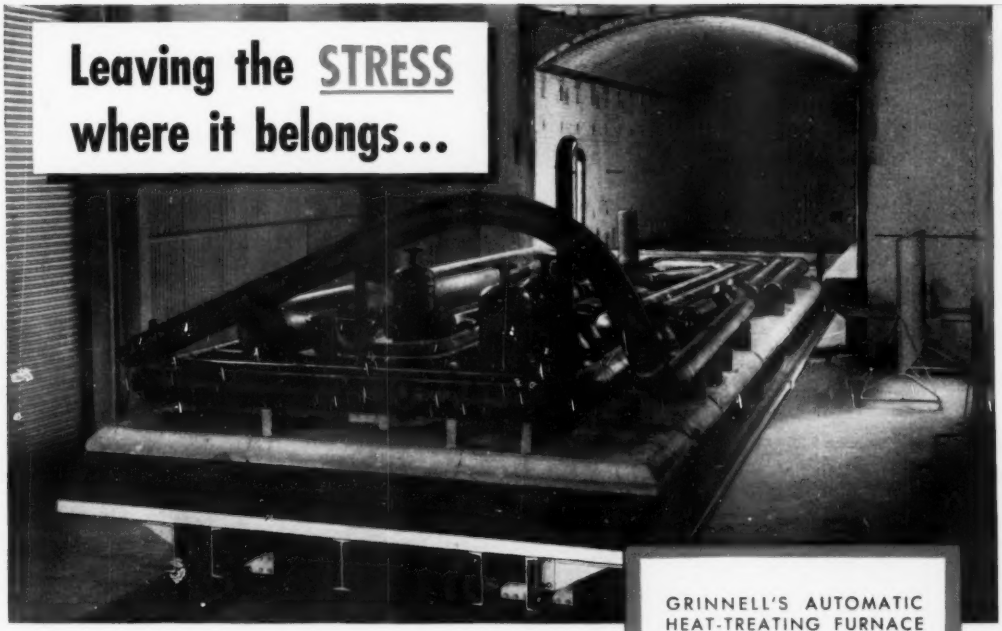
YOUR SCRAP IS NEEDED — YOUNGSTOWN

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

Leaving the STRESS where it belongs...



Stress relieving prefabricated piping with highly developed equipment and special techniques is one reason why exacting specifications are met with

GRINNELL PREFABRICATED PIPING

Grinnell received an order recently for stress relieving prefabricated piping to these specifications:—

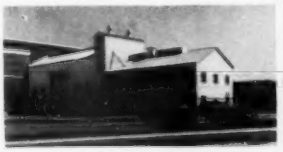
> "All fabricated pieces shall be normalized and drawn by heating to a uniform temperature of 1700°F (plus or minus 25°F). This temperature shall be maintained on a basis of one-half hour for each quarter inch of wall thickness of the heaviest pipe in the furnace charge followed by air cooling not less than 600°F. All pieces shall then be reheated to 1425°F and held at temperatures as above. In no case shall the time be less than 2 hours . . . Cool at a controlled rate not to exceed 200°F per hour until 600°F is reached . . ."

Grinnell, of course, met these specifications precisely. In fact, fabricating industrial piping today demands the *maximum* in versatility and precision.

Modern power plants, for example, need piping of heavy cross-sectional area and definite alloy composition to provide high temperature stability, resistance to creep and graphitization. Chemical and oil refining processes, on the other hand, must have piping of high chrome alloy to impart strength at high temperatures, resist corrosion, withstand impacts at low temperatures. Heat-treating often is the only answer — either to restore properties affected during fabrication, or improve original properties.

GRINNELL'S AUTOMATIC HEAT-TREATING FURNACE

performs with positive efficiency. This versatile stress-relieving unit, measuring 12 by 12 by 40 feet and using gas or oil or both as fuel, was designed to give full program control for the entire range of working temperatures. It provides instrument control of rate of rise in temperature of the charge, length of time for holding at the predetermined temperature level, and cooling rate. Two recording controllers are provided for the furnace and a separate 6-point recorder registers the temperatures of the charge simultaneously during the treating cycle.



Exterior View of Building

In heat-treating, as in everything else for piping, Grinnell has the experience and the costly equipment to fully protect large piping expenditures. That is why it will always pay you to call on Grinnell for *all* of your piping needs.

GRINNELL

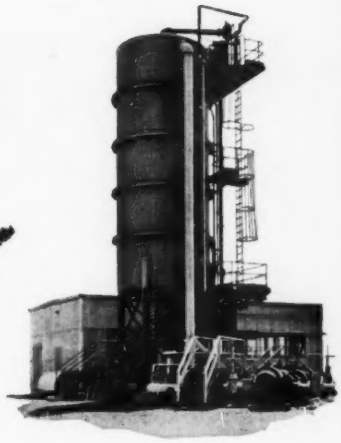
WHENEVER PIPING IS INVOLVED

Grinnell Company Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

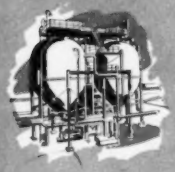
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

DEAERATED COOLING WATER SAVES ONE COMPANY

$85,500 a year!



THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS



1. SLUDGE BLANKET HOT LIME SODA. Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

2. HOT ZEOLITE—PERMUTIT Q. Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

3. SILICA REMOVAL PLUS DEMINERALIZATION. Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

4. DEAERATING HEATER. The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.

5. PRECIPITATOR. The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

REDUCES CORROSION RATE 90%
PREVENTS TUBERCULATION
CUTS TUBE REPLACEMENTS
LOWERS WATER CONSUMPTION

A chemical company in California installed a Permutit 5,000 gpm Vacuum Deaerator just over 2 years ago. Now here's what they have to say about it after exhaustive checking and comparison.

"The benefits occurring from water deaeration are difficult to calculate in their entirety, since so many of the advantages in small items such as clean water lines, better operation of valves, less frequent water line replacement and better water flow cannot be easily assessed. However, the major corrosion costs in this plant . . . have been determined and compared with the cost of deaeration . . ."

And the report goes on to cite actual net savings of $85,500 per year resulting from the installation of a Permutit Vacuum Deaerator.

Find out how Permutit can solve *your* water problems. Write to The Permutit Company, Dept. P2, 330 West 42nd Street, New York 36, N. Y., or The Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

PERMUTIT®

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS